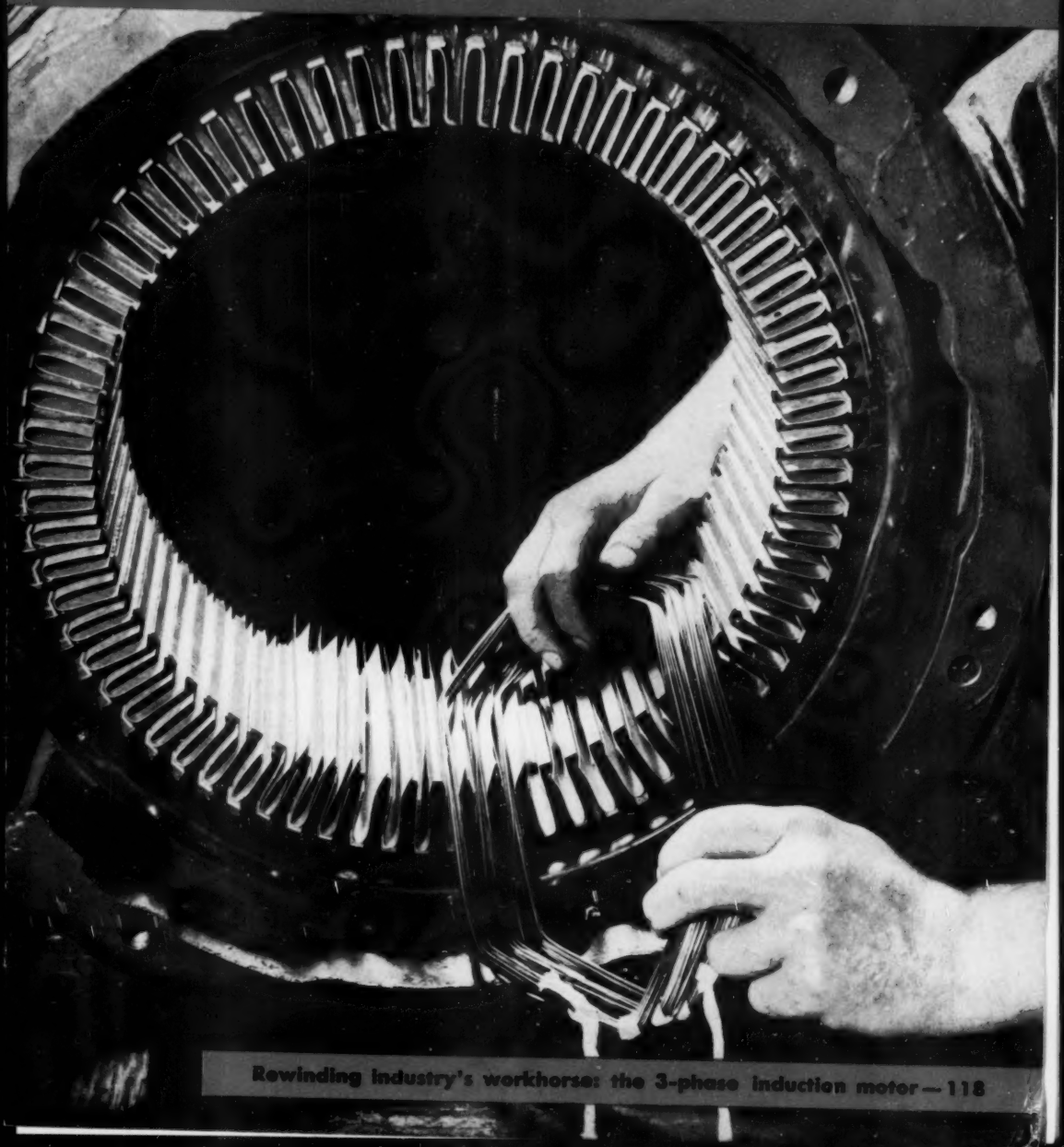
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

Power

HOW TO FILTER · 74
RECTIFIER ROUNDUP · 84
KEEP GAS SAFE · 108

August
1952 · 50¢

A McGRAW-HILL PUBLICATION



Rewinding industry's workhorse: the 3-phase induction motor — 118

Engineered "bum's rush"

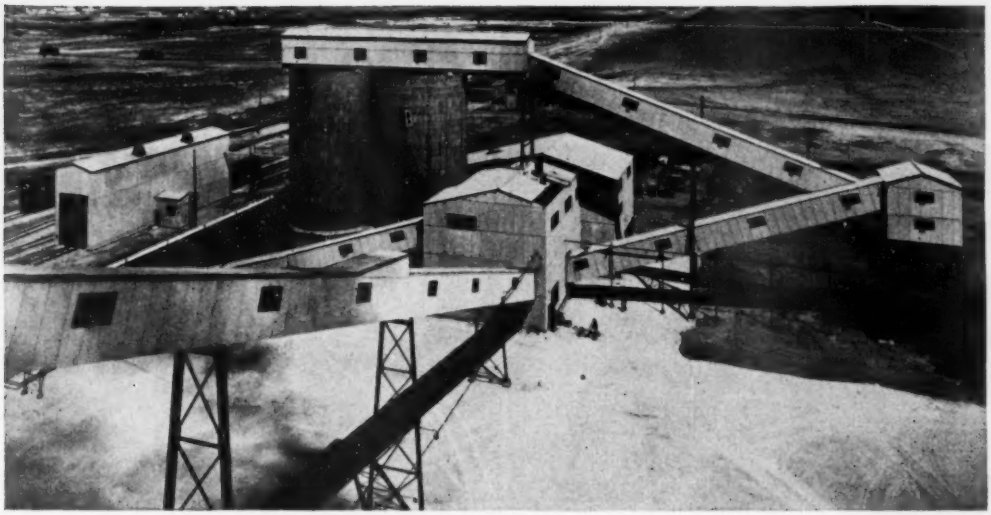
Ashes and dust have been getting a faster, cleaner ride out of power plants ever since A-S-H went into the business of engineering systems in the middle 'twenties. Profiting by their past experience with these streamlined disposal methods, today's power engineers depend on us for the solution to their problems of tomorrow. If you have a plant that's still in the planning stage or one that needs modernizing, you'll do well to get your ash and dust handling answers from our seasoned staff.

THE ALLEN-SHERMAN-HOFF CO., Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.

Offices and Representatives in Principal Cities

HYDROJET (hydraulic) **HYDROVAC** (pneumatic)

materials handling systems



This large industrial power plant moves 200 tons of coal per hour from track dump hoppers through storage silos to bunkers on Link-Belt Conveyors.

Rely on one source... one responsibility for the best in belt conveyors

LINK-BELT engineering experience plus quality components combine to cut handling costs

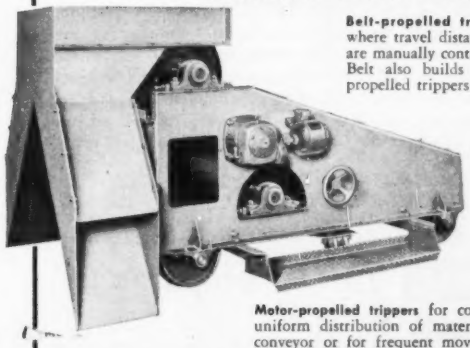
WHETHER you must move a few tons a day or several thousand tons per hour . . . whether the haul is measured in feet or miles—you'll find the answer in belt conveyors at Link-Belt.

Here's a nation-wide engineering organization that will follow through from start to finish—the designing, manufacturing, erecting of conveying equipment. And nowhere can you match Link-Belt's combination of vast application experience . . . complete line of quality components . . . expert coordination of related equipment.

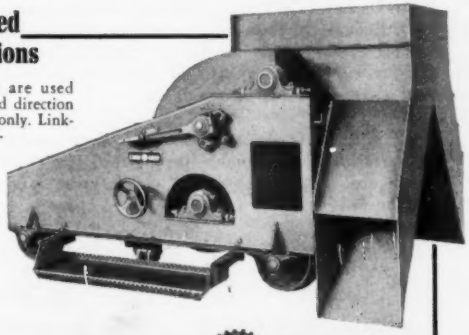
Get all the facts from the Link-Belt office near you. Link-Belt engineers are glad to work with you and your consultants—help you get the finest in belt conveyors.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in principal cities.

LINK-BELT Trippers offer controlled distribution under all conditions



Belt-propelled trippers are used where travel distance and direction are manually controlled only. Link-Belt also builds winch-propelled trippers.



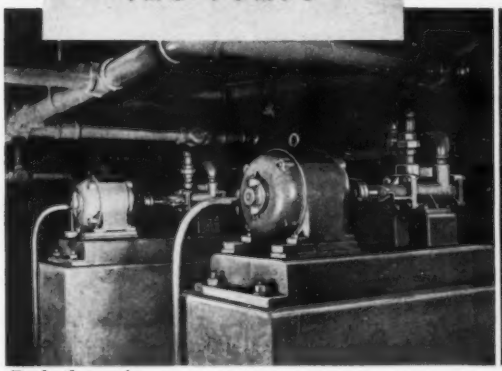
Motor-propelled trippers for continuous, uniform distribution of material along conveyor or for frequent movement to various fixed discharge locations.

LINK-BELT

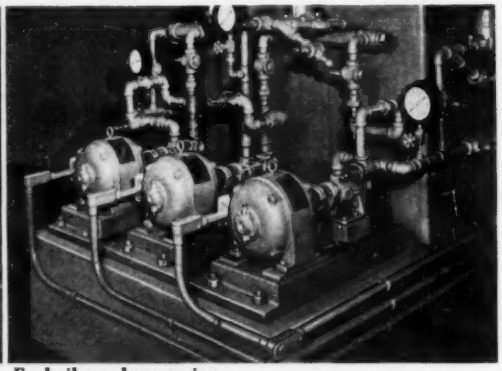
BELT CONVEYOR EQUIPMENT

DE LAVAL
IMO PUMPS

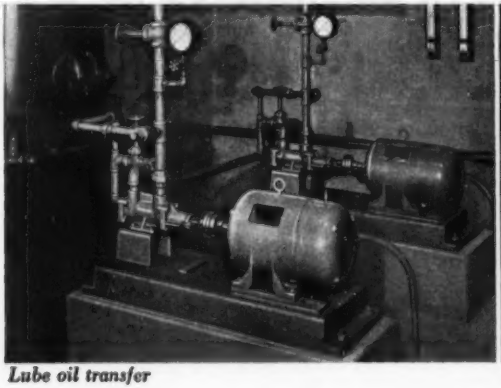
hold down 4 jobs at Owl's Head



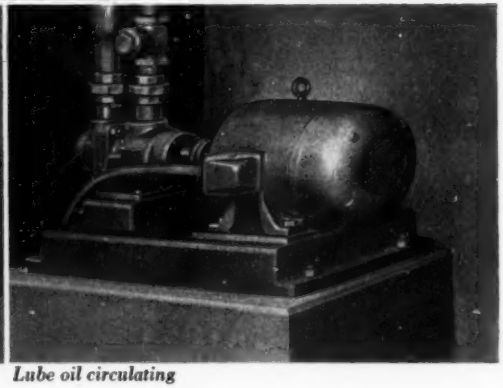
Fuel oil transfer



Fuel oil supply to engines



Lube oil transfer



Lube oil circulating

Again De Laval IMO rotary pumps prove their versatility. Eighteen of them are handling all the fuel and lube oil services for the six National Supply Company dual-fuel engines in the new Owl's Head sewage treatment plant in Brooklyn, New York.

The unique IMO design—*with only three moving parts*—assures long, trouble-free performance. IMO pumps are quiet, pulsation-free, compact and excellent for direct-connected high-speed operation.

Whether your power source is dual-fuel, gas or diesel engine, or oil-fired steam, be sure to specify IMO pumps for your next oil handling job. Use them in high and low pressure fuel oil burner sets, pumping fuel oil to burners, unloading and transferring fuel and diesel oil, handling oil for lighting off service and providing pressure lubrication on pumps and turbines. Send for Bulletin LG showing complete IMO line for capacities to 1,000 gpm at pressures to 500 psi and for capacities to 150 gpm at pressures to 1,500 psi.

DE LAVAL *IMO Pumps*

DE LAVAL STEAM TURBINE COMPANY
Trenton 2, New Jersey

DL 157

Power

AUGUST 1952 • VOLUME 96 NUMBER 8

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August 1952 **POWER** **Vol. 96—No. 8**

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INDUCTION MOTORS like the one pictured on our cover are a familiar sight throughout all industry. Rugged and reliable, they turn production wheels tirelessly if given routine inspection and maintenance. Yet even in the best-run plants, occasional carelessness or abuse knocks a motor out and a rewinding job is needed.

Whether motor overhaul is done in the plant, or by a contracting specialist, the plant engineer needs to know exactly what's involved in a first-class job. To get just that information, turn to pp 118-123. There you will find a picture story of stator rewinding; a later article will follow the steps in rotor overhaul.

Next month . . .

■ In terms of quantities used, water is far and away the No. 1 raw material of American industry. To power engineers responsible for its supply, water looks to be a growing problem as it becomes less plentiful and more costly. That's why you'll want to read our September feature on water. Its 48 pages divide into three parts:

■ The World of Water: Here is the fascinating story of water in nature, of the oceans, winds and weather that make us water-rich or water-poor.

■ Water Shortages in a Land of Plenty: Why shortages are occurring with greater frequency and what's being done about them.

■ A Water Program for Your Plant: How to appraise water needs for new or expanding plants, how to choose wisely among water sources, how to treat incoming water and what to do about outgoing wastes, how to use water wisely in your plant.

. . . and future months

■ Judging by the response, you liked our "4-star" film story on pump maintenance. We've got another on the way, telling how centrifugal pumps operate.

■ Centralized lubrication is beginning to catch hold in power stations. A coming story shows how it was applied in a hydro plant, and the results.

No Leakage
No Lubrication

That's why Ingersoll-Rand's advanced design

DMV and DHV PUMPS

can end your maintenance problems in general hydraulic service

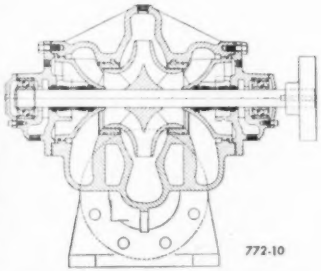
SINGLE-STAGE
DOUBLE-SUCTION
HEADS TO 340 FT.
CAPACITIES TO 2100 GPM
TEMPERATURES TO 200° F.

- **Extra Protection Against Shaft Leakage** through use of efficient *double* shaft seals in place of usual, packed stuffing boxes.
- **Double Shaft Seals** end stuffing box maintenance.
- **Longer Seal Life** assured with *double* shaft seals. Clean sealing water is injected to protect sealing surfaces when pumping gritty liquids.
- **Sealed, Cartridge-Type Bearings** require no lubrication throughout their service life.

These advanced design features make the DMV line the simplest and most maintenance-free single-stage double-suction pumps ever developed by Ingersoll-Rand for general hydraulic service. Ask your nearest I-R representative for complete information on this latest pumping development.

✔ Double Mechanical Shaft Seals

✔ Permanently Lubricated Ball Bearings



772-10

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COMPRESSORS • PUMPS • AIR AND ELECTRICAL TOOLS • VACUUM EQUIPMENT • ROCK DRILLS • CONDENSERS • GAS AND DIESEL ENGINES

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...with Power readers...

BTU'S GET TOGETHER . . .

When we finish with our Btu's they are too weak to hold a conference. Looks like this is a job for Power to correct.

Savannah, Ga. C W HACKETT

When the above note arrived, the thermometer was scrambling into the upper 90's and our first reaction was that the heat had gotten us, or, perhaps, Reader Hackett. Then we noticed a clipping from the *Savannah Morning News* attached to the letter. Sure enough, the headline said "TWELVE B.T.U.'S HAVE CONFERENCE." What with the heat and all, we were almost ready to believe that the Btu's in Georgia were getting together, perhaps to unionize for better working conditions. Our hopes of a real technical scoop were dashed by the lead paragraph of the story, however. There it was made plain that the B.T.U.'s referred to were department leaders in the Baptist Training Union. Regretfully we canceled hastily formed plans for stopping the presses to make way for an epoch-making announcement and went back to trying to avoid the effects of the over-abundant Btu's in New York's summer atmosphere. Incidentally, Reader Hackett, we're ready to take on any assignment dealing with garden-variety BTU's, but we wouldn't even try to "correct" the Baptist variety. No sir!—*Ed.*

(*Continued on page* 206)

...lines and bylines

Walter Prise

MOTOR KNOWHOW is the stock in trade of Walter Prise and the organization he's been with the past three years—The Maintenance Co, specialists in servicing and repair of electrical machinery. It was in their shops that the photos for Walter's picture story on motor rewinding (pp 118-123) were taken—in the course of an actual job.

Before joining Maintenance, Walter saw quite a bit of the world, beginning with China, where he took mechanical and electrical degrees at Harbin Polytechnic. He also has a BSEE from the University of California. In 17 years of practical experience he has worked for utilities and shipyards in various parts of the U.S., spent some time on radar development and served as a consultant.

Walter is active in AIEE's rotating-machinery committee, serving as a member of the dc subcommittee. He's also national publicity chairman for National Industrial Service Assn and acts as consulting editor for *Electrical Construction and Maintenance*. These assignments testify to his interest in writing, which he lists as one of his hobbies. The other—more fun, *we* think—is sailing.

T J Barrett

AIR CONDITIONING, in one form or another, is a pet subject with Tommy Barrett. In what might be called its *straight* form, it plays a big part in his job as building superintendent of the world-famous Waldorf-Astoria.

Backed by 25 years of experience with marine and stationary equipment of all kinds, Tommy directs an engineering force of more than 100 in the never-ending task of maintaining and improving the equipment of his "city within a city." For some slants on how he does it, see p 116.

Tommy is also neck-deep in that large-scale form of air-conditioning known as smoke prevention. As national director of NAPE's air-pollution program, he has spark-plugged their contributions to development of sound local ordinances and to the encouragement of correct operating methods that attack air pollution at its source.

C F Marschalek

ART EDITOR is the title you'll find beside Charlie Marschalek's name on POWER's masthead. Because it falls short of accurately describing his contribution to your magazine, we'd like to tell you about his work.

In modern technical publishing, we don't "write" articles and then "illustrate" them. From the beginning, we plan *word* elements (headlines, captions, text) and *picture* elements (photos, drawings, charts) to form a meaningful whole that gets across ideas in the fastest and easiest fashion. In this planning, Charlie, a specialist in organizing material on the printed page, consults with our technical editors every step of the way from idea, to "visual" or layout, and to the finished article.

Charlie likes to spend out-of-office hours hiking and taking color photos. Right now he's vacationing in Europe, doing both.

B&W EXPANDS FOR

MORE

Many new B&W boilers are under construction and on order to supply steam requirements for several million kilowatts of new generating capacity.

POWER FOR AMERICA

Keeping pace with the nation's continuing industrial expansion, The Babcock & Wilcox Company is completing this year a multi-million-dollar increase in facilities for the manufacture of boilers for electric generating stations, industrial plants, institutions, public buildings and apartment houses, chemical plants, oil refineries, and merchant and naval vessels.

Two new plants are already in production at Wilmington, N. C. and West Point, Miss. A third one is being built at Paris, Texas. Thousands of additional employees have been trained to man these new plants, and to work expanded fabricating facilities at five other B&W plants. New machines and processes . . . including the world's largest boiler plate press . . . are setting new standards of production efficiency and speed.

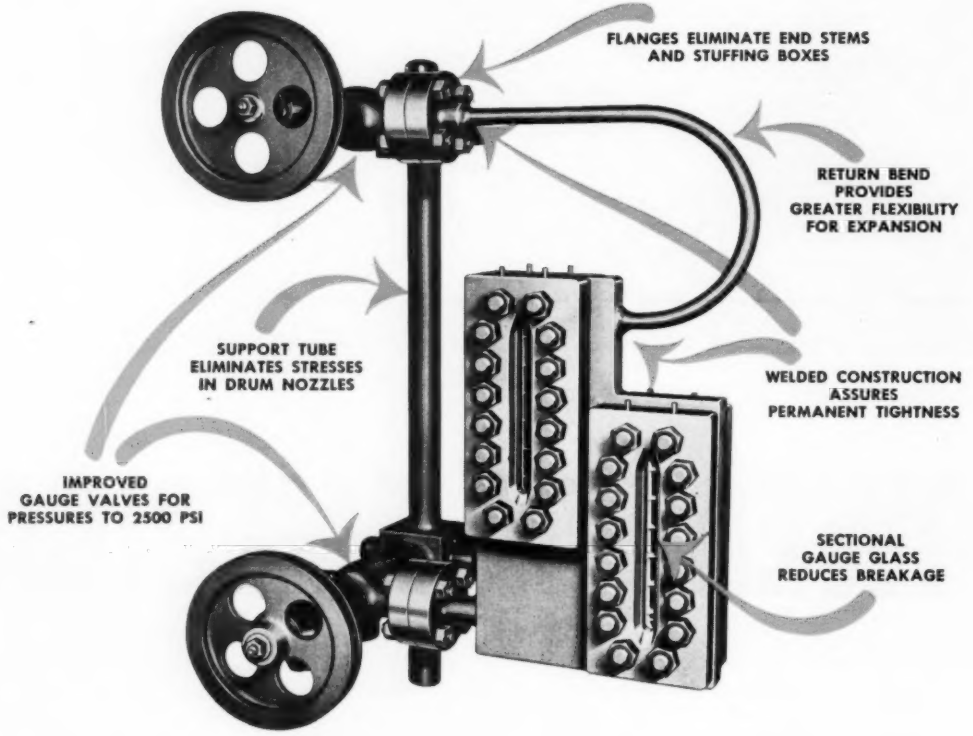
Through its expanded facilities for production of more steam generating equipment, B&W shares in America's dynamic urge to accomplish as reflected in industry's phenomenal, growing capacity to mass produce.

BABCOCK & WILCOX

G-570T

New DIAMOND Flange Connected WATER GAUGES

More Suitable to High Pressure Operation


FLANGES ELIMINATE END STEMS AND STUFFING BOXES
RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION
SUPPORT TUBE ELIMINATES STRESSES IN DRUM NOZZLES
WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS
IMPROVED GAUGE VALVES FOR PRESSURES TO 2500 PSI
SECTIONAL GAUGE GLASS REDUCES BREAKAGE

In addition to the advantages shown above, this gauge provides maximum level visibility with minimum drum nozzle spacing. Greater reading accuracy is another important feature. The bend (which is uninsulated) provides sufficient condensing area to assure active circulation of hot condensate through the gauge. This maintains the gauge at higher temperature so there is less difference between boiler water and gauge water density. That and the shorter gauge assure greater accuracy.

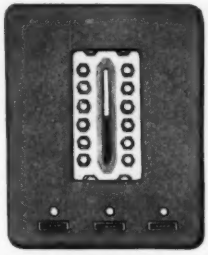
Write for new Bulletin No. 1051 describing Diamond Water Gauges and Water Columns.

DIAMOND POWER SPECIALTY CORPORATION

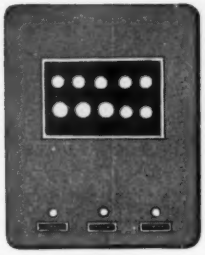
LANCASTER, OHIO

Diamond Specialty Limited—Windsor, Ontario 4860

Rapidly Growing LIST OF UTILITIES Using the DIAMOND "UTILISCOPE" (WIRED TELEVISION)

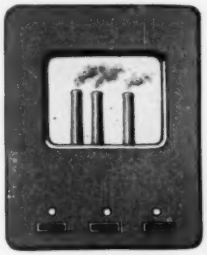


Boiler water level observation



Burner pilot observation

Boiler furnace combustion observation



Stack smoke discharge observation

Utilities listed below have purchased the Diamond "Utiliscope" for one or more of the uses shown. Images are brought to the boiler control panel where the operator can see them at all times.

***Ohio Power Co.**
Tidd Station
Muskingum River Plant

***Consolidated Edison Co.**
Hellgate Station
Hudson Avenue Station
Waterside Station
East River Station

***Commonwealth Edison Co.**
Fisk Street Station
Ridgeland Station

***Board of Water & Electric Light Comm.**
Ottawa Station,
Lansing, Mich.

***Cincinnati Gas & Electric Co.**
Miami Fort Station
Clermont Station
Walter C. Beckjord Station

***Illinois Power Co.**
Wood River Station

***Oklahoma Gas & Electric Co.**
Mustang Station

***Indiana & Michigan Elec. Co.**
Twin Branch Station
Tanners Creek Station

***Appalachian Electric Power Co.**
Phillip Sporn Station
Kanawha Station
Graham Station

***Northern Indiana Public Service Co.**
Michigan City Station

Public Service Co. of Indiana
Noblesville Station

Union Electric Power Co.
Venice Station

Northern States Power Co.
Minneapolis Station

***Dayton Power & Light Co.**
Hutchings Station

Buffalo-Niagara Electric Corp.
Huntley Station

***Duke Power Co.**
Dan River Station
Lee Station
Riverbend Station

Union Electric Co. of Missouri
Meramac Station

Elecktricitateetssakskabet
Kydnby Power Station
Isefyordraerkat,
Denmark

***Niagara Mohawk Power Corp.**
Dunkirk Station
Oswego Station
Huntley Station
Albany Steam Station

***Societa Edison—Centrale diGenova**
Genova, Italy
Piacenza, Italy

Central Hudson Gas & Electric Corp.
Danskammer Station

***Tennessee Valley Authority**
Johnsonville Steam Plant
Widows Creek Plant
Shawnee Steam Plant
Kingston Steam Plant

Chicago District Electric Generating Corp.
State Line Station

***Public Service Co. of N. Illinois**
Station No. 6
Dixon Station

Kansas Gas & Electric Co.
Murray Hill Station

***Long Island Lighting Co.**
Port Jefferson Station
Far Rockaway Station
Glenwood Landing Station

Toledo Edison Co.
Acme Station

***Philadelphia Electric Co.**
Delaware Station
Richmond Station

Cleveland Electric Illuminating Co.
Eastlake Plant

Indianapolis Power & Light Co.
White River Station

Virginia Electric Power Co.
Chesterfield Station

***Southern California Edison Co.**
Etiwanda Station

San Diego Gas & Electric Co.
Silver Gate Station

Monongahela Power Co.
Albright Station

***Electricite de France**
Nantes Chivire Station
Arrighi Station

***New York State Electric & Gas Corp.**
Goudey Station
Greenidge Station

***Repeat orders have been received from these utilities.**

The "Utiliscope" is simple, stable, remarkably durable. It requires no technical skill for operation. Cost is low and is quickly amortized by labor saving and improved operation. Write for Bulletin 1025. "U"

"UTILISCOPE" REGISTERED U. S. PATENT OFFICE

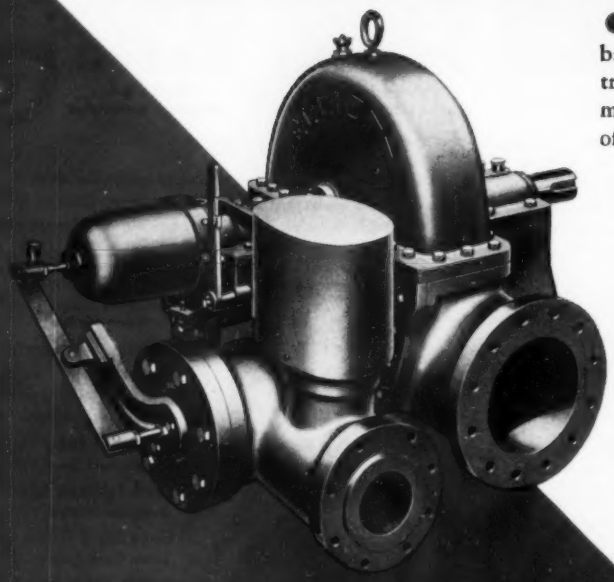
DIAMOND POWER SPECIALTY CORP.
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO • OFFICES IN 39 PRINCIPAL CITIES
Diamond Specialty Limited — Windsor, Ontario
Since 1903, Diamond has Manufactured Quality Equipment For Industry

WRITE FOR BULLETIN 1025

Both strong in

YR Turbines

ELLI



This turbine makes friends everywhere, in all industries, for its tailor-made adaptability, its simplicity, its extremely reliable performance, its surprisingly low maintenance—all qualities of highest value. Capacities to 2000 hp. Speeds, 800-7000 rpm.

● YR Turbines are built on a production basis, but engineered to allow an extremely wide range of modifications to meet specific conditions. Here are some of them:

- **Five frame sizes —**
- **Eight different turbine types —**
- **Your choice of several governors each independent of the standard overspeed governor —**
- **Six elective control devices, including:**

1. Two hand valves controlling nozzling
2. Hand-operated speed changer
3. Remote control speed changer, air or electric
4. High exhaust pressure trip
5. Remote control electrical trip
6. Hand throttled emergency trip valve.

- **Gland seal piping for condensing operation, or operation with gas —**
- **Exhaust connection on either side.**

ELLIOTT

STEAM TURBINE DEPT. • JEANNETTE, PA.

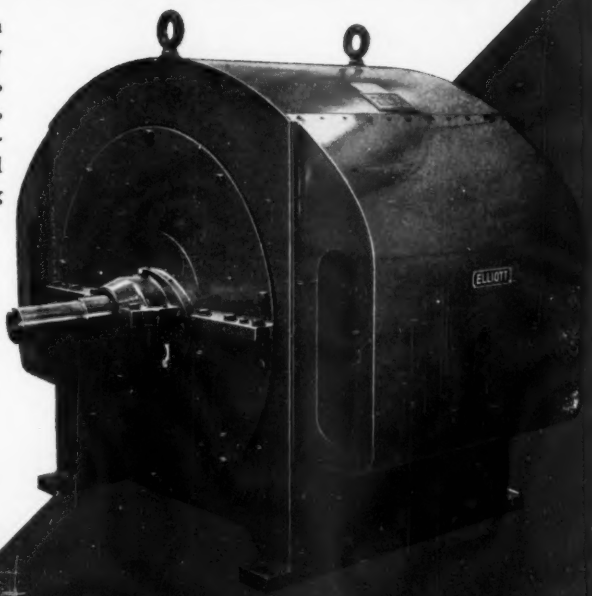
Plants in JEANNETTE, PA. • DISTRICT OFFICES IN PHILADELPHIA.

adaptability!

OTT Fabri-steel motors

Fabri-steel motors have established an entirely new set of standards in their easy applicability to individual conditions, some of them most difficult. For instance, the standard Elliott squirrel-cage induction motor, without change in electrical design, can be supplied with the following enclosures:

1. Outdoor splashproof
2. Vertical outdoor splashproof
3. Indoor splashproof
4. Frame modified for top discharge
5. Enclosed self-(base) ventilated
6. Totally enclosed, fan-cooled with top-mounted air-to-air heat exchanger
7. Totally enclosed, water-cooled with side-mounted air-to-water heat exchanger
8. Round frame for mounting inside a duct system with a forced-draft fan impeller mounted on tapered shaft extension.



Co[illegible]

DEP[illegible] HIGHWAY DIVISION • [illegible]HWAY, PA.

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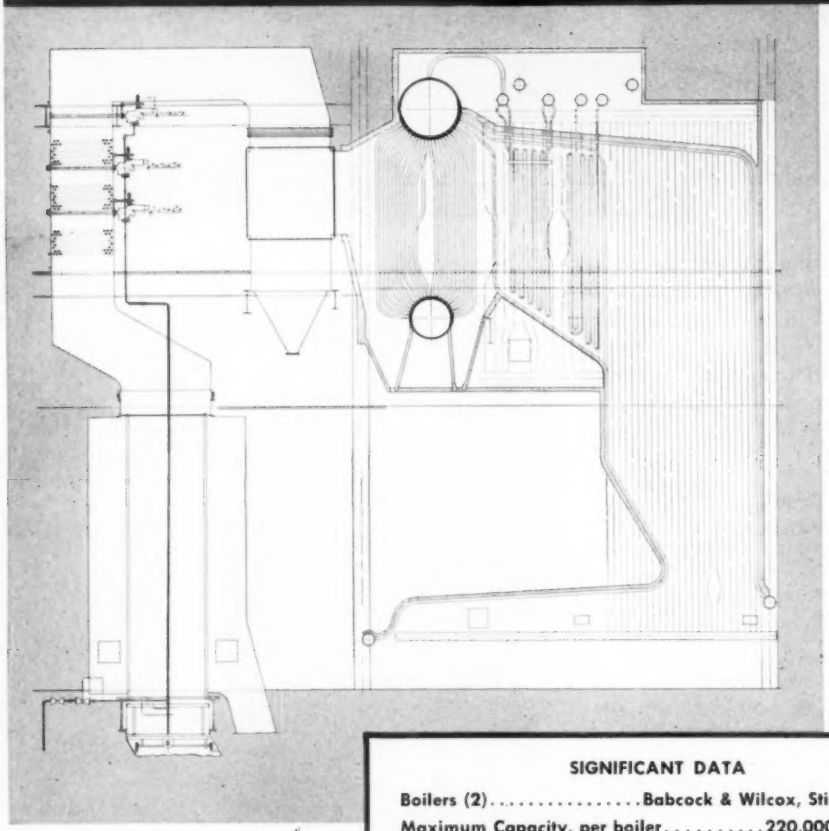
Now it's VULCAN



SIGNIFICANT DATA

Boilers (2)	Babcock & Wilcox, Stirling Type
Maximum Capacity, per boiler	220,000 lb per hr
Steam Pressure at Superheater Outlet	875 psi
Steam Temperature at Superheater Outlet	960 F
Firing with	Anthracite; traveling-grate stokers
Soot Blowing	Vulcan Automatic-Sequential System, with rotary units and traveling frame air heater cleaners. All electric drive. Blowing medium: air
Consulting Engineers	Gilbert Associates, Incorporated

Vulcan Automatic

for Hickling Station

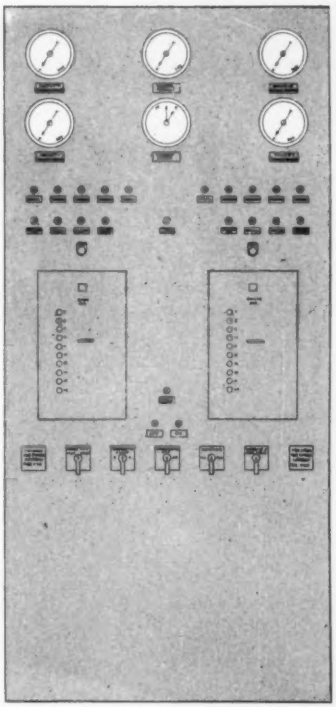
with automatic-sequential control

NEW YORK STATE ELECTRIC & GAS CORPORATION has again selected Vulcan Automatics to clean important new boilers. This time the installation will be made on Units 3 and 4 at Hickling Station, East Corning—two of the largest anthracite traveling-grate stoker-fired boilers ever built. The all-electric Vulcans will be under automatic-sequential control.

This utility's first Vulcan Automatics will be found at Jennison Station, Bainbridge, with remote push button control.

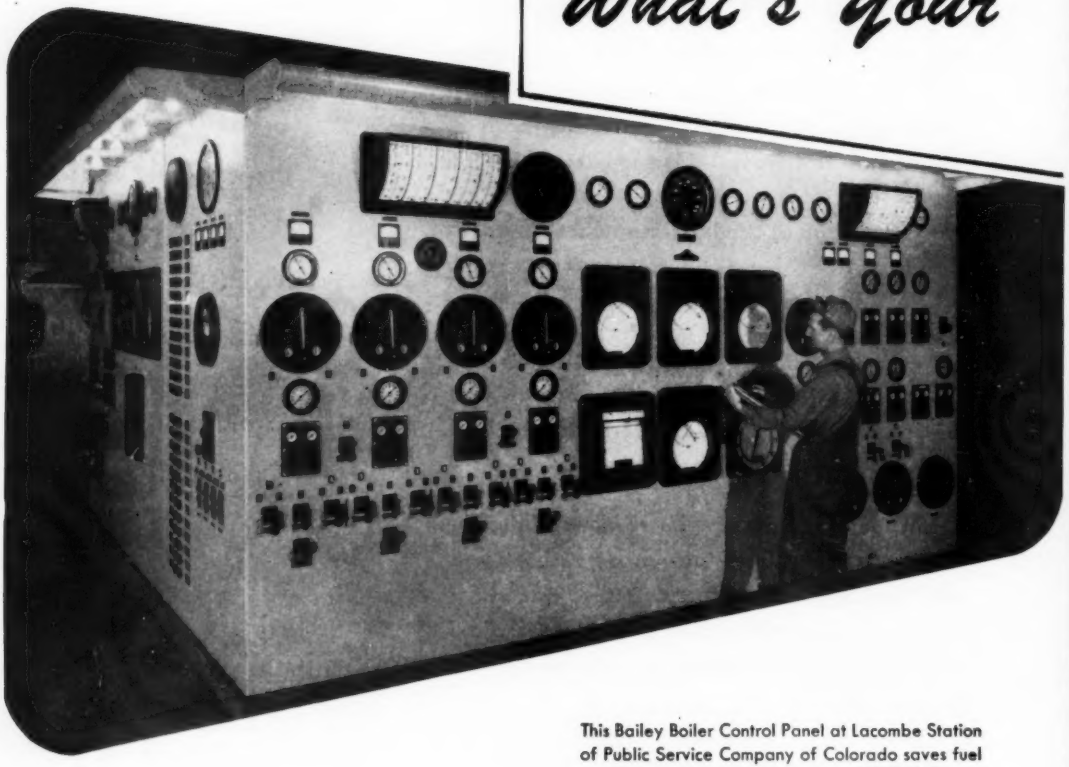
Whether your boilers be large or small—industrial or utility—power or process—you can depend on Vulcan to give you most effective cleaning at low overall cost. And to provide fully-automatic control from a central panel.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA



Without leaving this panel, the operator can start the blowing cycle on either automatic or selective sequential control, or by remote manual operation. He can also check proper operation of each blower by signal lights.

What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

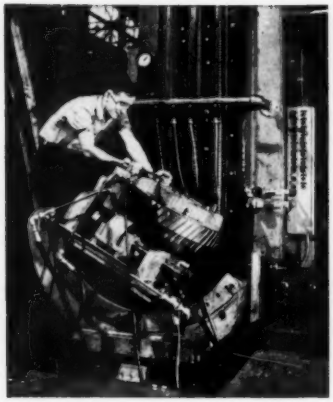
For better control-dollar efficiency—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-2

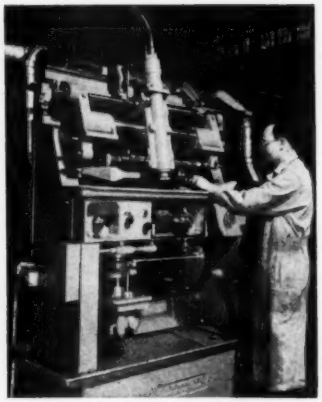
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

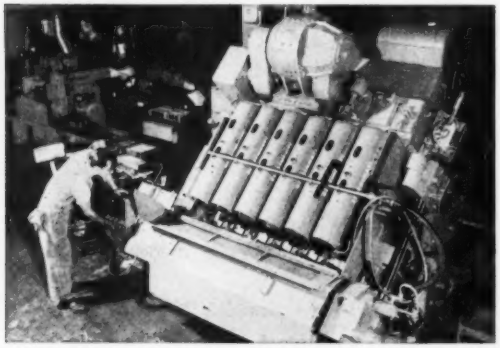
This accuracy check on turbine bucket dovetails is one of many quality controls.



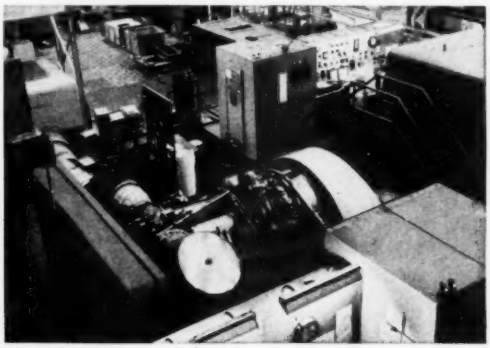
Automatically operated, this three-station broach cuts dovetails in compressor wheels.



An automatic polisher brings machined compressor blades to their final contour.



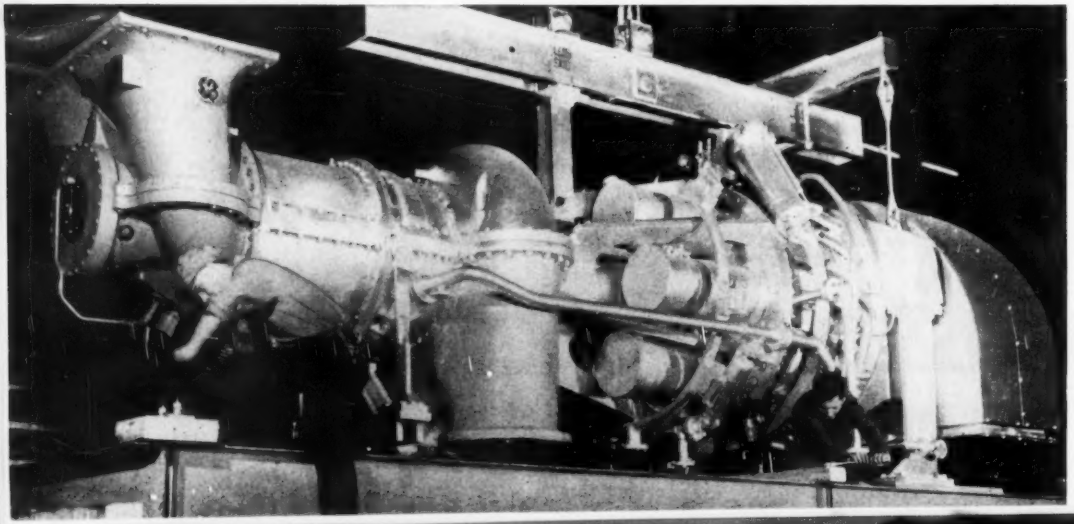
This machine simultaneously cuts six compressor blades or turbine buckets from blank stock to within 0.005 in. of finished dimension.



Testing includes checking of mechanical balance, performance, bearing operation and emergency and speed regulating governors.

General Electric's Gas Turbine Plant

ASSEMBLED UNITS LEAVING THE FACTORY ARE READY FOR PERMANENT INSTALLATION WITH A MINIMUM EXPENDITURE OF TIME AND LABOR.



One of the bays in General Electric's gas turbine plant at Schenectady, N. Y. Units are being assembled for locomotive, pipeline pumping, and power generation service.

Now Tooled for Continuous Production

With the recent addition of a number of specialized machine tools, General Electric's gas turbine manufacturing facilities are virtually complete. Production, testing, and shipment are on a regular schedule in the Schenectady, N. Y., plant. In fact, the 1952 order board calls for delivery of 46 units—six for freight locomotives, 34 for natural gas pumping stations, and six for power generation service in electric utilities. An even larger total will be produced in 1953.

Components for the 3500 kw simple-cycle, the 3500 kw regenerative-cycle, and the 5000 kw compound-cycle designs are in continuous production.

Recently, the first regenerative-cycle machine completed factory tests and is now being installed. This design, distinctive for its flexibility, is suitable for utility application in a variety of arrangements involving the combined use of both gas and steam turbine cycles.

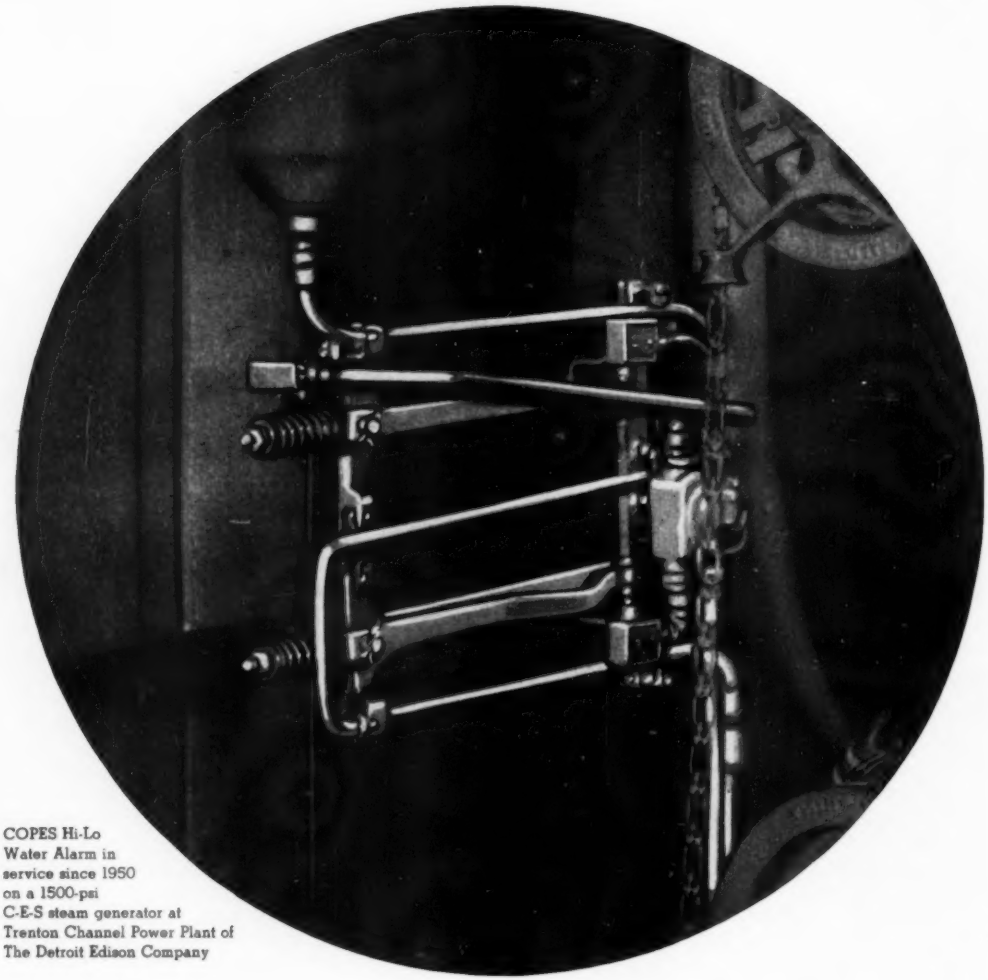
Of particular importance are the refinements in manufacturing procedures which have come about as the result of operating experience with half a dozen units in customer installations. A large fund of data on fuels, design details, and performance has been accumulated.

Thus, in less than five years, a completely new development has become an established product. America's newest prime mover is making a significant contribution to the nation's over-all program for power expansion. General Electric Company, Schenectady 5, N. Y. 255-6

GENERAL ELECTRIC

COPES Hi-Lo

as simple and dependable



COPES Hi-Lo
Water Alarm in
service since 1950
on a 1500-psi
C-E-S steam generator at
Trenton Channel Power Plant of
The Detroit Edison Company

ENGINEERED BY THE MAKERS OF

WATER ALARM

as the COPES expansion tube

HERE'S a new Hi-Lo Water Alarm, based on exactly the same established principle that has made the COPES Feed Water Regulator so successful for the last fifty years.

On both stationary and marine boilers, it gives trouble-free dependability at all working steam pressures.

Simple, fool-proof and maintenance-free. Compact and self-contained. Easily installed without special supports or complicated piping—with or without a water column

Bulletin 493 tells the full story. Write for it.

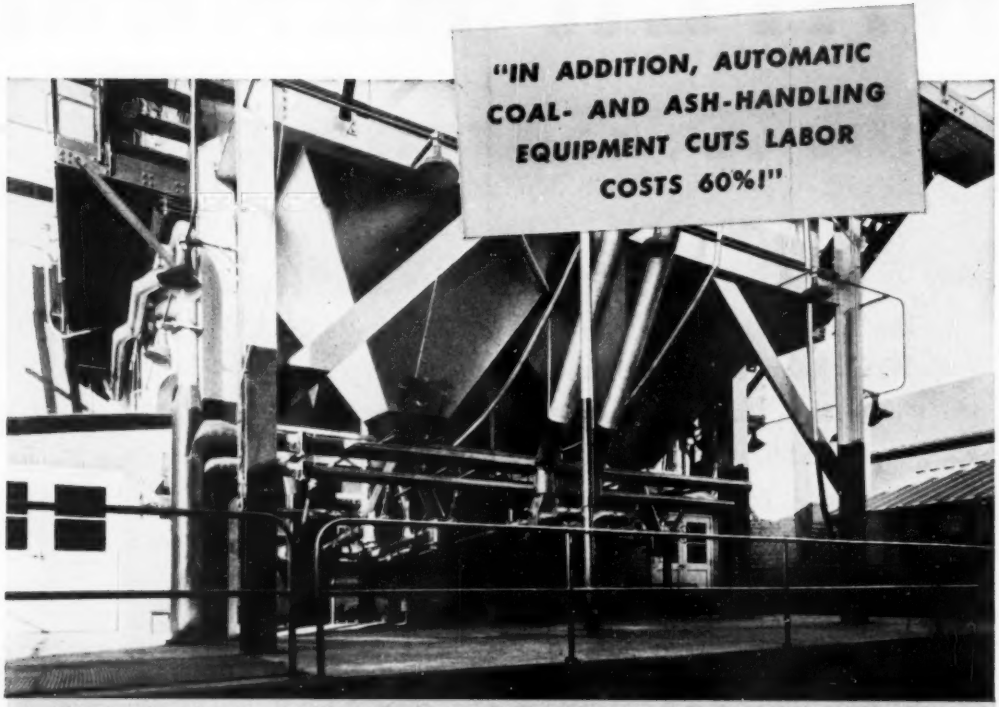
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

The COPES Hi-Lo Alarm uses no bellows, no diaphragms, no weights, no floats, no differential pressure devices. It has no internal parts to corrode or wear. Standard audible signal is a horn; standard visible signal, lights. Other types of signal can be furnished as desired.

COPES

FEED WATER REGULATORS

"WE MODERNIZED OUR PLANT, INSTALLED



This view shows how River Raisin has installed its modern fly-ash re-injection system at the rear of the boilers but outside the plant. The plant also features outdoor coal handling to save additional interior space. Coal is delivered to the stoker hoppers through automatic scales which weigh and record the flow.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

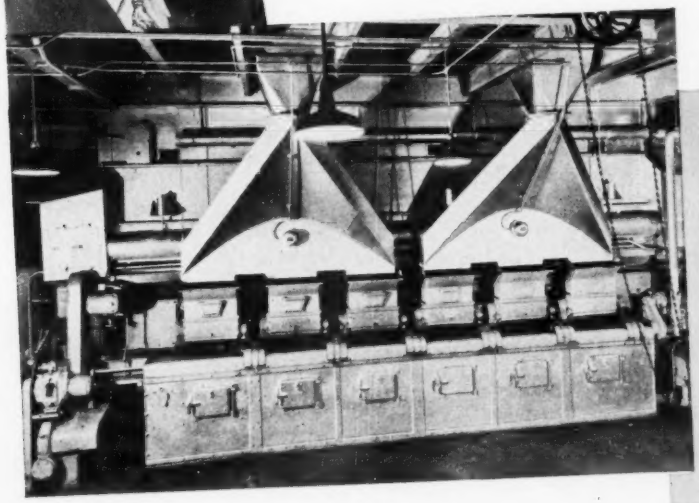
COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY—FOR LOW COST

NEW COAL-BURNING EQUIPMENT, AND CUT OUR FUEL COSTS 45%!"

says Mr. A. J. Goetz, Executive Vice President, River Raisin Paper Co., Monroe, Michigan.

"We recently modernized our entire plant following an extensive engineering survey. New coal-burning equipment was installed...our coal-handling system was redesigned...heat losses were reduced...efficiency raised. As a result, our fuel costs have been cut 45 to 50%—proving to us that for economy and efficiency you just can't beat bituminous coal burned the modern way."



"These modern spreader stokers fully meet the special requirements of our operation. They feature low power requirements, low maintenance, and have the ability to meet fairly rapid load changes. They give us maximum efficiency under all operating conditions."

Modernizing your present plant? Building a new one? In either case it will pay you to get the *modern* facts about coal from a consulting engineer. He'll show you how an up-to-date coal installation can meet your *specific* needs—and at the same time save you more money than you thought possible.

With automatic coal- and ash-handling equipment you can cut labor costs to a minimum . . . and a modern combustion installation will give you more steam for less fuel. Actually, today, you can get from 10 to 40% more power from each ton of coal than was possible a few years ago.

And, if you burn coal, you'll never have to worry about a shortage of fuel. America's coal reserves are virtually inexhaustible, and this coal is mined by one of America's most efficient and productive industries.

This means that coal users—unlike those committed to other fuels—get the advantage of dependable future supply as well as the most stable prices.

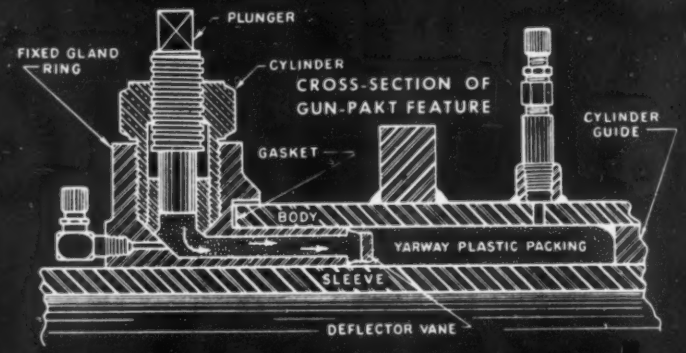
BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

TYPICAL USERS

Philadelphia Electric Company
Toledo Edison Company
Georgia Power Company
Union Electric Company (St. Louis)
Wisconsin Electric Power & Light Company
Rochester Gas & Electric Company
Ohio Edison Company (Akron)
Public Service Co. of Colorado
Allegheny County Steam Heating Company
Buick Motor Company
Ford Motor Company of Canada
Standard Oil Company (Illinois)

this expansion joint



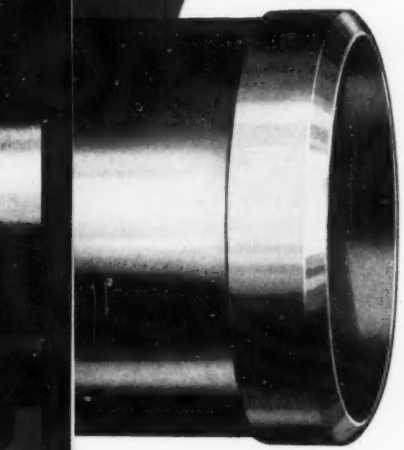
Delco-Remy Company
Magnolia Petroleum Corp. (Texas)
International Paper Company (Florida)
Armstrong Cork Company
General Electric Company
Westinghouse Electric Corporation
Purdue University
University of Chicago
University of Indiana
Leland Stanford University
Michigan State College
Sanoma State Hospital (California)
Jacksonville State Hospital (Illinois)
Massillon State Hospital (Ohio)
Massachusetts Institute of Technology

YARWAY

offers...

FREEDOM

FROM SHUTDOWNS



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineering. Its success is shown by wide use in leading [illegible] stations, institutions and [illegible]

[illegible] Gun-Pakt story . . . get Yarway Bulletin 1912. Write to . . .

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Pa.

Branch Offices in all principal cities

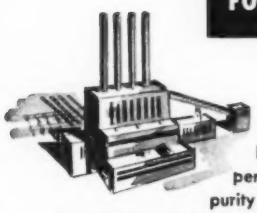
GUN-PAKT EXPANSION JOINT

From the pioneering development in Superheaters to the

the trend in modern steam generator design

places the spotlight on . . .

FOSTER WHEELER combination radiant and convection



Today's central station calls for larger unit sizes of turbines and boilers—higher steam pressures and temperatures—and optimum quality and performance. To provide steam in the quantity, pressure, temperature and purity demanded, increased emphasis falls upon the design and function of superheaters and reheaters. Their integration with other components of equipment and plant requires the high degree of skill and experience that comes only with years of leadership in the field.

Foster Wheeler's pioneering effort in steam generator design, as reflected in the following record of achievement, has led the way for every major development in the reheat cycle.

1902 — Superheated steam introduced commercially in the United States.

1904 — Convection superheaters standardized with cast iron extended surface rings applied to steel tubes. Bare tubes were later used with improved design technique and improved metal selection.

1919 — Radiant superheaters developed after long research and experimentation.

1924 — Water walls and water backs applied to many types of furnaces burning various fuels.

1926 — Radiant reheaters and radiant superheaters installed in one of the first large high pressure reheat units in the country.

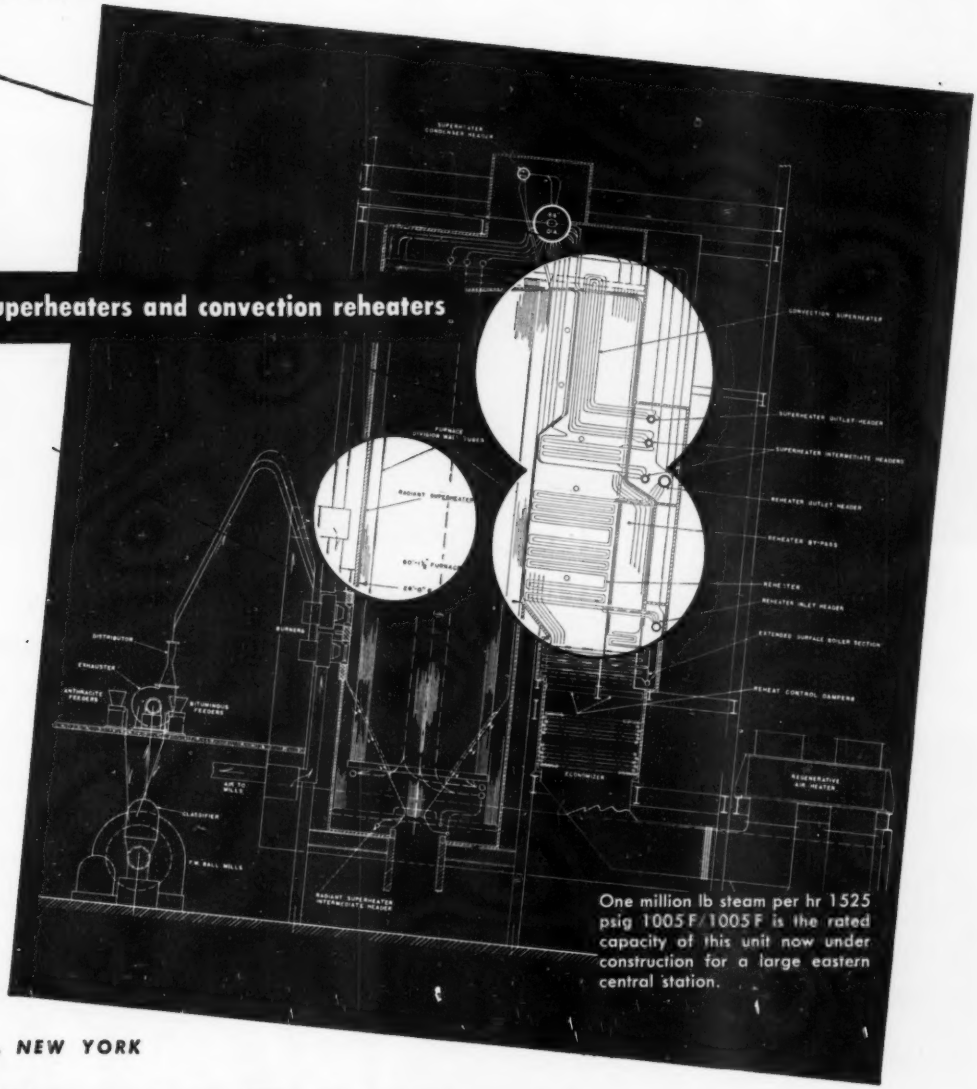
1946 — First large steam generator installed in a central station to operate over a wide load range at 1000 F final steam temperature.

As a result of this 50 years' background of experience and leadership, each new steam generator can be depended upon to have Foster Wheeler's integrated quality and performance.

FOSTER WHEELER CORPORATION • 165 BROADWAY • NEW YORK

complete reheat cycle

superheaters and convection reheaters

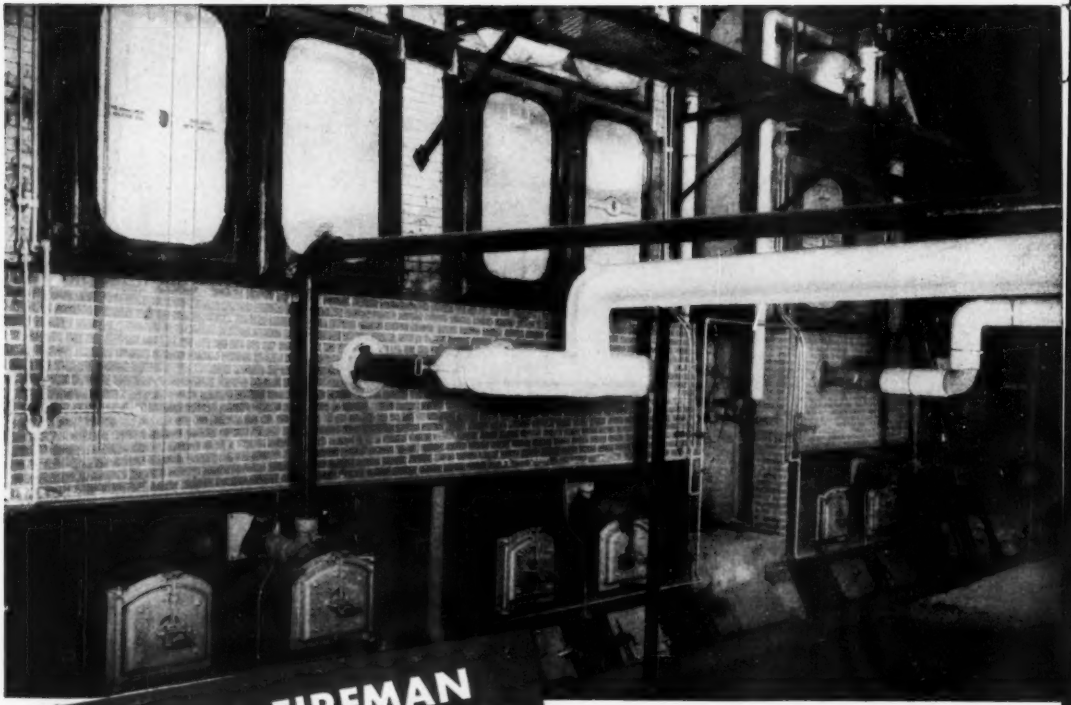


One million lb steam per hr 1525 psig 1005 F/1005 F is the rated capacity of this unit now under construction for a large eastern central station.

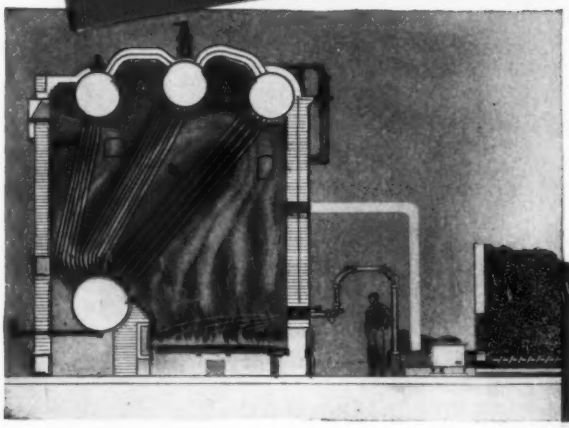
6, NEW YORK

FOSTER WHEELER

Coal handling and coal firing . . .



IRON FIREMAN PNEUMATIC SPREADER STOKER



CONVEYS DRY COAL ON STREAM OF PRE-HEATED AIR

Coal is thoroughly dried and pre-heated before it is conveyed pneumatically to furnace grates. Dry coal assures far more uniform distribution. The distributor nozzle spreads the dry coal over the *entire* grate in a shallow, uniform fuel bed and not simply on the front of the grate as is usually the case with wet coal. Preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness as compared with stokers which do not pre-heat coal.

IRON

. . . combined IN ONE UNIT

HANDLES COAL AUTOMATICALLY

DRIES AND PRE-HEATS COAL

BURNS ECONOMY COALS

Burns all grades and types of BITUMINOUS COAL from ¼" slack to 2" top size

The Iron Fireman Pneumatic Spreader stoker is more than just a stoker. It is a complete COAL HANDLING AND COMBUSTION SYSTEM. No other stoker combines its many exclusive features and money saving "extras."

Manual coal handling or expensive handling equipment are completely eliminated—and without extra cost. Coal is conveyed pneumatically, direct from bunker or bin to the furnace grates.

The Iron Fireman Pneumatic Spreader stoker burns all grades and sizes of bituminous coals, including low ash fusion, sub-bituminous and lignite—ranging from ¼" slack to 2" top size. In addition, it is ideally adapted to burning the better quality grades of bituminous coal.

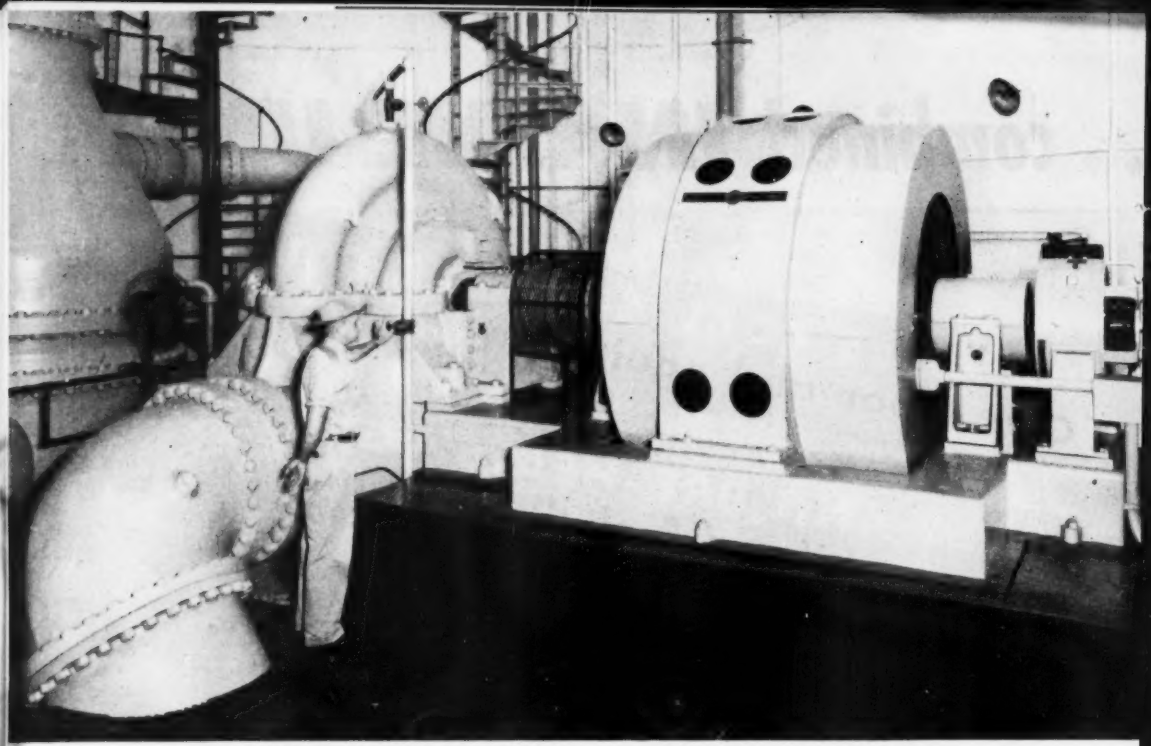
Coal is thoroughly dried and pre-heated before it is conveyed to the furnace and distributed over the grates. This assures far more uniform distribution over the *entire* grate.

Fuel feed and air volume rate are automatically synchronized. Air supply is kept in step with coal feed-rate at all times. The exclusive Iron Fireman infinitely variable transmission, combined with the Iron Fireman Volumeter, assures maximum efficiency at all rates of operation.

You save in other ways, too. The Iron Fireman Pneumatic Spreader stoker is readily adaptable to any boiler room layout—and without costly alterations. Coal bunkers or bins can be located in almost any position relative to the boilers—even on another level above or below the firing floor. Maintenance costs are low. All moving parts are located away from the direct heat of the combustion chamber. Easy to inspect and service. Capacities available to 1,000 boiler horsepower in single units. Multiple units for larger capacities.

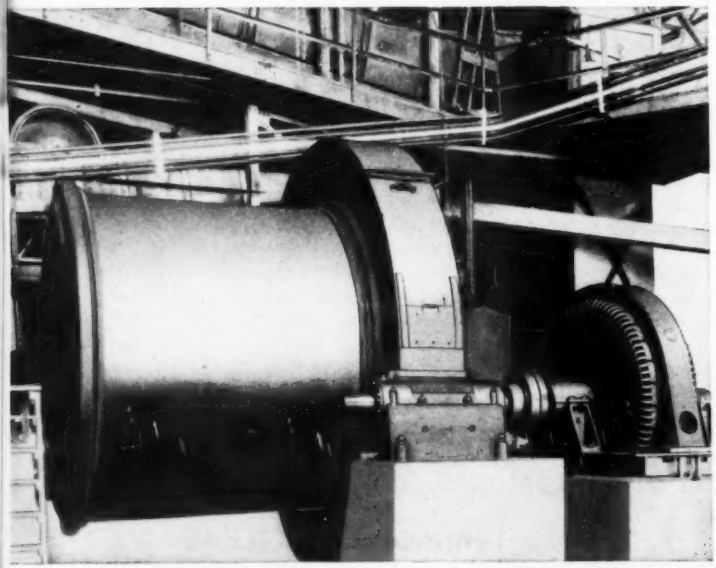
Find out today how Iron Fireman firing will cut fuel and labor costs in your boiler room. A survey in your plant, made without cost or obligation to you, will show you. For such a survey, or descriptive literature, write Iron Fireman Mfg. Co., 3249 W. 106th St., Cleveland 11, Ohio, or call your nearest Iron Fireman dealer.

FIREMAN

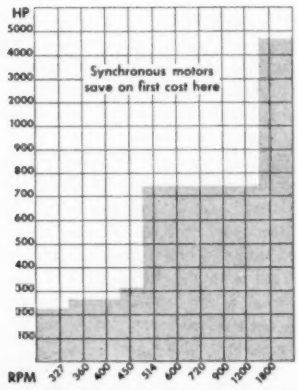


Savings in distribution equipment investment were made possible by selection of this General Electric 2500 hp synchronous motor for a municipal pumping station.

G-E Synchronous Motors

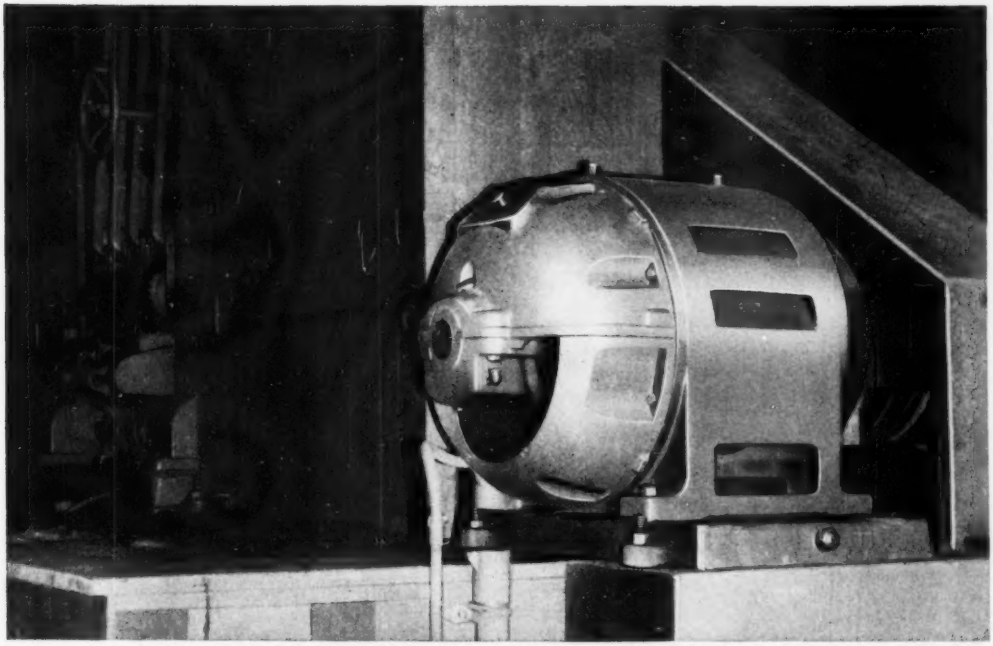


To meet the tough starting requirements of a ball mill, a mining company chose this G-E high-torque synchronous motor rated at 600 hp. Initial cost was low and the motor has given 20 years of dependable service.



Lower first cost of G-E synchronous motors is shown above. For applications in the white area, synchronous motors cost less than any other kind of motor. Calculations below show power savings on a typical 1000 hp, 514 rpm motor.

Gain in efficiency over other types of motors at same rating	**2.2%**
Hourly saving at power rate of $0.01 per/kwh	**$0.184**
Yearly saving (assuming constant operation)	**$1600.00**



Lower operating cost is the rule when General Electric Tri-Clad* synchronous motors are used with equipment such as this horizontal band re-saw, operating almost continuously at heavy loads.

Offer Double Savings

Lower First Costs, Lower Operating Costs Can Be Realized on Large, Constant-Speed Applications in Many Industries

Before you select a drive for a large equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. On many applications such as pumps, compressors, fans, etc., outstanding savings are available.

LOWER FIRST COSTS

In most ratings where horsepower is equal to or greater than speed, the price tag on a synchronous motor with exciter and control is less than that of any other a-c motor with its control.

And, because a synchronous motor improves plant power factor, initial investment in distribution equipment frequently can be reduced. (The load which any new or expanded power system will carry is proportional to the plant's power factor.)

LOWER OPERATING COSTS

A synchronous motor usually has a higher full-load efficiency than any other type of motor, produces more work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0% in efficiency pays off.

Engineers with many years of field experience will tailor G-E synchronous motors and control to your job. Call in your General Electric representative—he'll be glad to discuss your particular application. And for more information on G-E synchronous motors, write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) to Section 770-26, *General Electric Company, Schenectady 5, N. Y.*

BE SURE TO SPECIFY G-E SYNCHRONOUS MOTORS

The result of more than 55 years experience in development, manufacture, and successful application, General Electric's line of synchronous motors is available in low speed and high speed types, engine-type and Tri-Clad* construction.

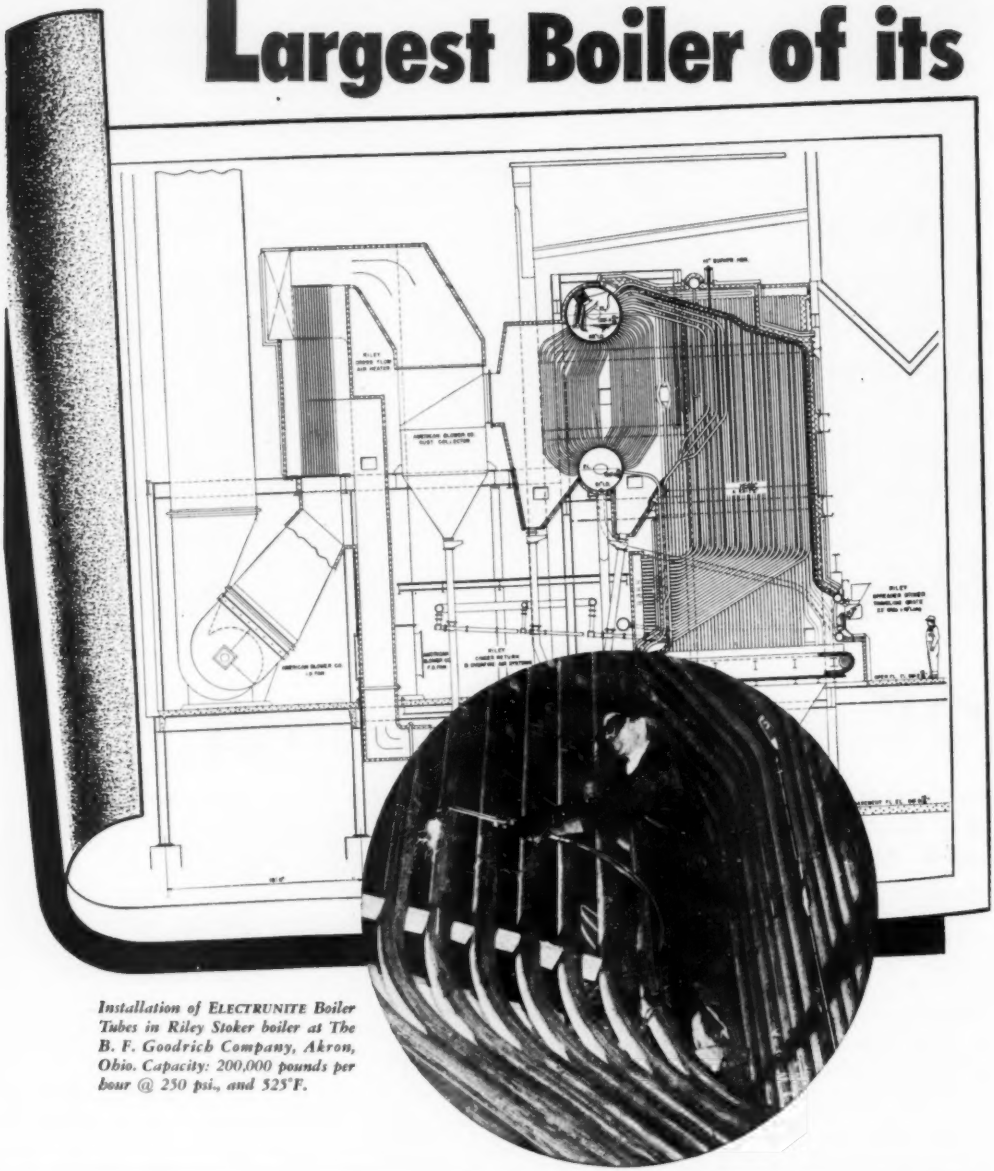
Numerous exclusive design and construction features promote long, dependable service. Get the full details!

Reg. trademark U.S. Pat. Off.

GENERAL ELECTRIC

770-26

Largest Boiler of its



Installation of ELECTRUNITE *Boiler Tubes in Riley Stoker boiler at The B. F. Goodrich Company, Akron, Ohio. Capacity: 200,000 pounds per hour @ 250 psi., and 525°F.*

REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION

224 EAST 131st ST. • CLEVELAND 8, OHIO

type in Ohio...

and Tubed with

ELECTRUNITE BOILER TUBES

At B. F. Goodrich plant, new Riley Stoker boiler tubed with ELECTRUNITE *Boiler Tubes is installed in this addition to the power house.*

● Far up in the 38-foot height of this new Riley Stoker Boiler at The B. F. Goodrich Company's Akron steam plant, erectors are installing ELECTRUNITE Boiler Tubes. These tubes will help produce 200,000 pounds of steam per hour at 250 psi., and 525°F. This is the largest spreader-stoker-fired boiler in Ohio.

ELECTRUNITE Boiler Tubes are uniform in wall thickness and ductility. They bend uniformly without stretching or buckling, and roll-in smoothly to assure tight, weeper-free joints.

These tubes are uniformly corrosion-resistant all around the diameter and from end-to-end. Full-normalizing assures uniform ductility at every point along the length, also assures clean, scale-free surfaces.

When you're ordering boilers or heat exchangers, specify "Republic ELECTRUNITE Pressure Tubes". When you're retubing, make it a longer time between retubings . . . use ELECTRUNITE Tubes.

Republic REPUBLIC STEEL

ELECTRUNITE

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

THE ORIGINAL ELECTRIC-WELDED PRESSURE TUBES

Good Engineering Counts

—ESPECIALLY WITH 3500 HP AT STAKE

THESE 3500-HP, 3582-RPM MOTORS are driving boiler-feed pumps in a midwestern power plant. They were purchased only after a thorough check of Allis-Chalmers two-pole cage motor design details. And their operating reliability has proved that A-C engineering can meet the requirements of the largest boiler-feed pump drives in the power industry. A-3806

GET THE INSIDE STORY — For more information about large two-pole motors, ask your A-C representative for Bulletin 05B7550. Smaller cage motors are described in Bulletin 51B7693. Allis-Chalmers, Milwaukee 1, Wis.

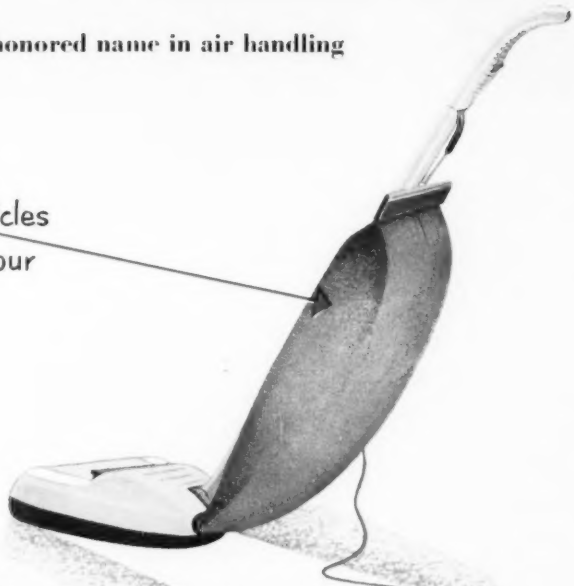
Here are Some of the Features

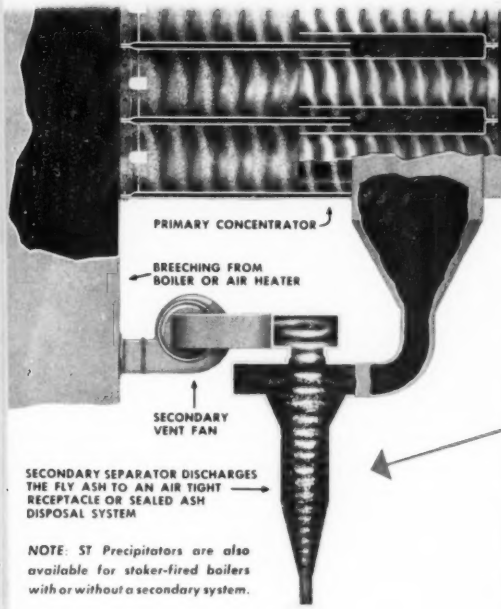
- Separate steel balancing rings to provide dynamic balancing without weakening the end rings.
- *Dew-drop* bars that give better performance and stay tight in the rotor core slots.
- Forged end rings, drilled to receive the cage bars.
- Oxygen-free copper or deoxidized copper-base alloy bars and end rings to prevent embrittlement from silver-brazing.
- Air distribution arrangement that eliminates hot spots in both the stator and the rotor.
- Ring-oiling adequate for prolonged emergency operation without forced-feed oiling.
- Equalizing air pressure chambers in the bearing housings to positively keep oil out of the motor windings.

ALLIS-CHALMERS A-C ALLIS-CHALMERS

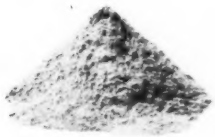
American Blower . . . a time-honored name in air handling

This collects the particles of dust from air in your vacuum cleaner




BREECHING TO INDUCED DRAFT FAN
PRIMARY CONCENTRATOR
BREECHING FROM BOILER OR AIR HEATER
SECONDARY VENT FAN
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

NOTE: ST Precipitators are also available for stoker-fired boilers with or without a secondary system.



This collects the particles of fly ash, released by burning pulverized fuel in a power plant

Both are important tools in better housekeeping. One for the home. The other for the community. Ask about American Blower Type ST Fly Ash Precipitator, *now!*

AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

For information concerning American Blower or Canadian Sirocco power plant equipment, please call the nearest Branch Office or Sales Representative. They are strategically located for your convenience in the cities listed below.

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*Albuquerque, New Mexico
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Baltimore, Maryland
Birmingham, Alabama
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Buffalo, New York
Charleston, West Virginia
Charlotte, North Carolina
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Cleveland, Ohio
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Louisville, Kentucky
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STAINLESS STEEL DEAERATING TANK is hoisted in place during construction of one of Detroit Edison Company's Heating Plants at Detroit, Michigan.

When CO_2 Caused a Headache ...Worthington Cured It

Detroit Edison had the solution to its problem —the problem of CO_2 in its steam—except for one thing.

Zeolite-softened municipal water used in their steam plant contains high percentages of carbonates which decompose and generate CO_2 in the boilers. Carried over with the steam into heating and processing equipment, that CO_2 could cause plenty of trouble.

The CO_2 problem was solved by Detroit Edison engineers by acid treating the softened water, converting the carbonates to CO_2. The gas thus formed is driven off in a deaerator.

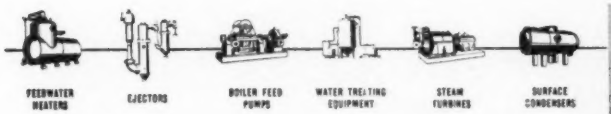
However, no standard deaerator could successfully remove the large quantities of CO_2 released by the acid treatment, and deliver water to the boiler with practically zero oxygen and zero CO_2. Furthermore, standard materials would have lasted only a few months under such conditions.

NON-CONTAMINATED STEAM

Worthington provided the answer. Detroit Edison engineers selected a Worthington deaerator specially designed for these severe conditions, built entirely of stainless steel, and guaranteed to deliver water containing not over 0.005 ppm of oxygen and not over 0.1 ppm of CO_2. The result is steam containing so little CO_2 that the amount *cannot be accurately measured!*

On problems like this one, Worthington not only furnishes *all* of the equipment needed in a complete water treating installation, but also has the engineering ability to work with your engineers on the *complete* problem of generating steam for power or processing. For further information on why *there's more worth in Worthington*, address Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

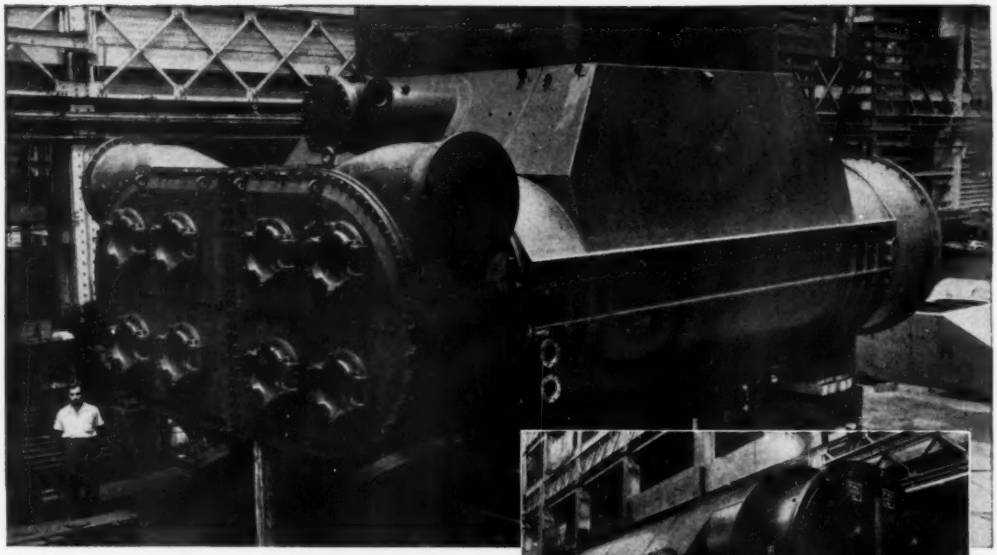
S12



A GREAT TEAM IN STEAM

WORTHINGTON

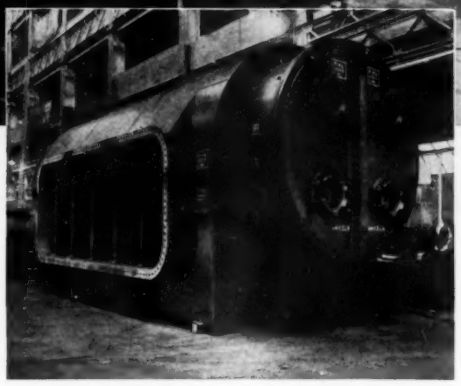
Feedwater Heaters



LOW-HEADROOM, OVAL-TYPE CONDENSER (with extraction heater in exhaust neck), is typical of several furnished in sizes ranging from 27,500 to 80,000 sq. ft.

"TAILORED TO FIT"

Low-headroom design for condensers typical of Worthington "space" engineering



SIDE INLET CONDENSER, one-half of several "twin shell" units serving turbine-generators of 20,000 to 100,000 kw

It all began in 1854.

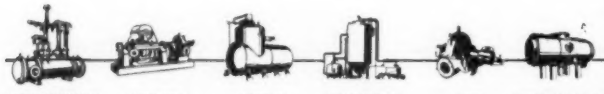
That was the year the first Worthington condenser was installed. From that time, up through the early twentieth-century "evolutionary" period in condenser design, Worthington has constantly kept in step with prime mover and steam power plant development. Today, engineers must design and build condensers within the limitations imposed by high construction costs.

Thanks to the flexible nature of the Worthington "Double Folded Tube Layer", today's "low-headroom" requirements are easily met without any sacrifice in efficiency. For single-shell, beneath-turbine installations, the rectangular box-type (built by Worthington as early as 1904) has given way to the modern "oval" design illustrated above. Other designs include single-shell, side-mounted units with exhaust elbows, and twin shells with horizontal or "T" shaped exhaust connections, popular for outdoor or semi-outdoor plants.

As the capacity of turbine-generators increases, so does the demand for larger condensers. This places more importance on "space" engineering. Worthington—with over a century of experience in the manufacture of steam power equipment—is prepared to build efficient condensers in all sizes to suit any reasonable limitations. (Now under construction for an eastern utility is the largest single-shell unit ever ordered—125,000 sq. ft.)

Write for advice on your new installation, stating requirements. Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

Z.2.1

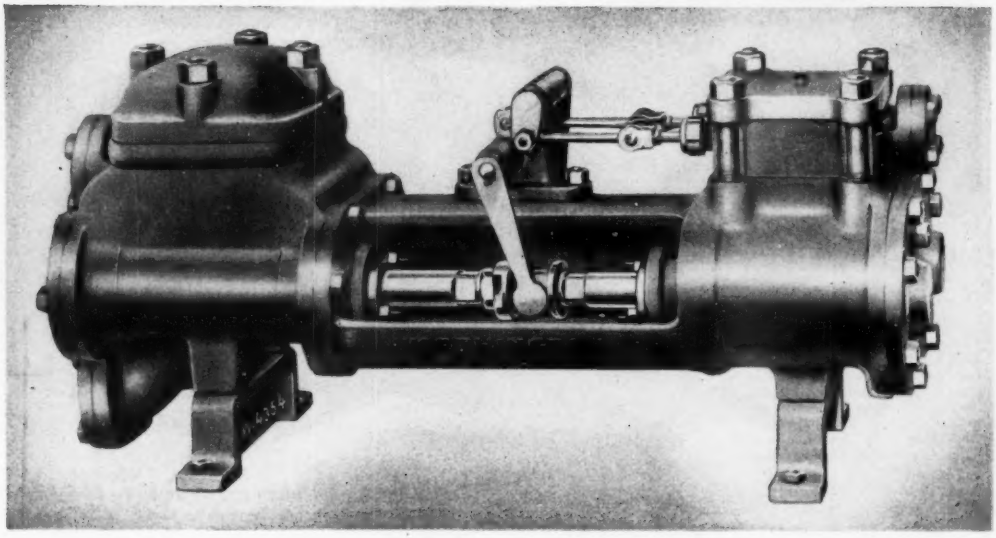


A GREAT TEAM IN STEAM

WORTHINGTON

Condensers

This is a throttle valve



. . . And so is this!

You may think you're getting the most out of the steam in your plant—but here's an idea that's slipped by the best of them.

If your plant uses steam, you undoubtedly use throttle valves—and you undoubtedly use pumps. But have you ever considered using a pump that can do the two jobs more economically than one?

A steam pump can do just that—as a pump it pumps, and as a steam "consumer" it serves nicely as a throttle valve to reduce the pressure with only a small loss in heat energy. Big point is that it does all this on power that's otherwise wasted. THE POWER'S THERE, WHY NOT USE IT?

MODERN WORTHINGTON STEAM PUMPS OFFER YOU ALL THESE ADVANTAGES

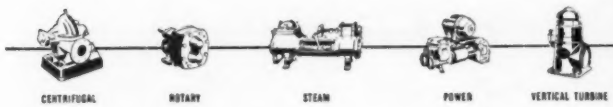
THEY'RE FLEXIBLE because capacity can be easily varied. And exhaust steam can be used for process work or heating.

THEY'RE SIMPLE—any mechanic can operate or maintain one with ease. There's very little that can go wrong. No motors or couplings to maintain.

THEY'RE LONG-LIVED because they operate at slow speeds minimizing wear. Features: 250-pound steam end, lubricated drop forged valve gear, integral cast cradle.

For seven reasons why Worthington steam pumps lead the field, write for Bulletin W111-B13B to Worthington Corporation, Reciprocating Pump Division, Harrison, N J.

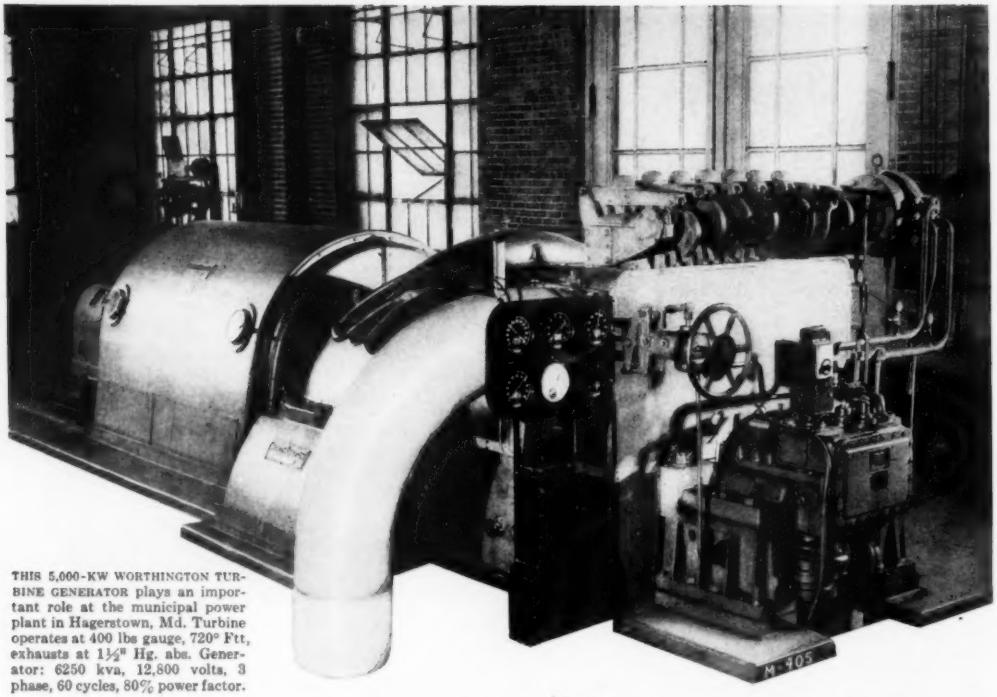
P.2.5



The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Steam Pumps



THIS 5,000-KW WORTHINGTON TURBINE GENERATOR plays an important role at the municipal power plant in Hagerstown, Md. Turbine operates at 400 lbs gauge, 720° Ftt, exhausts at 1½" Hg. abs. Generator: 6250 kva, 12,800 volts, 3 phase, 60 cycles, 80% power factor.

WORTHINGTON turbine generator at City of Hagerstown, Md. completes second year of continuous operation

A little over two years ago Hagerstown, Maryland, took one of the biggest steps in its $1,500,000 post-war power-plant expansion program. They installed and began operating a 5,000-kw Worthington turbine generator unit.

Fulfilling the reputation for reliable performance held by all members of Worthington's team in steam, this power supply has run continuously since installation.

Hagerstown is just another of the many Worthington users that are reaping the rewards of the experience and specialized engineering that go into the manufacture of these long-life, ever-dependable turbine generators.

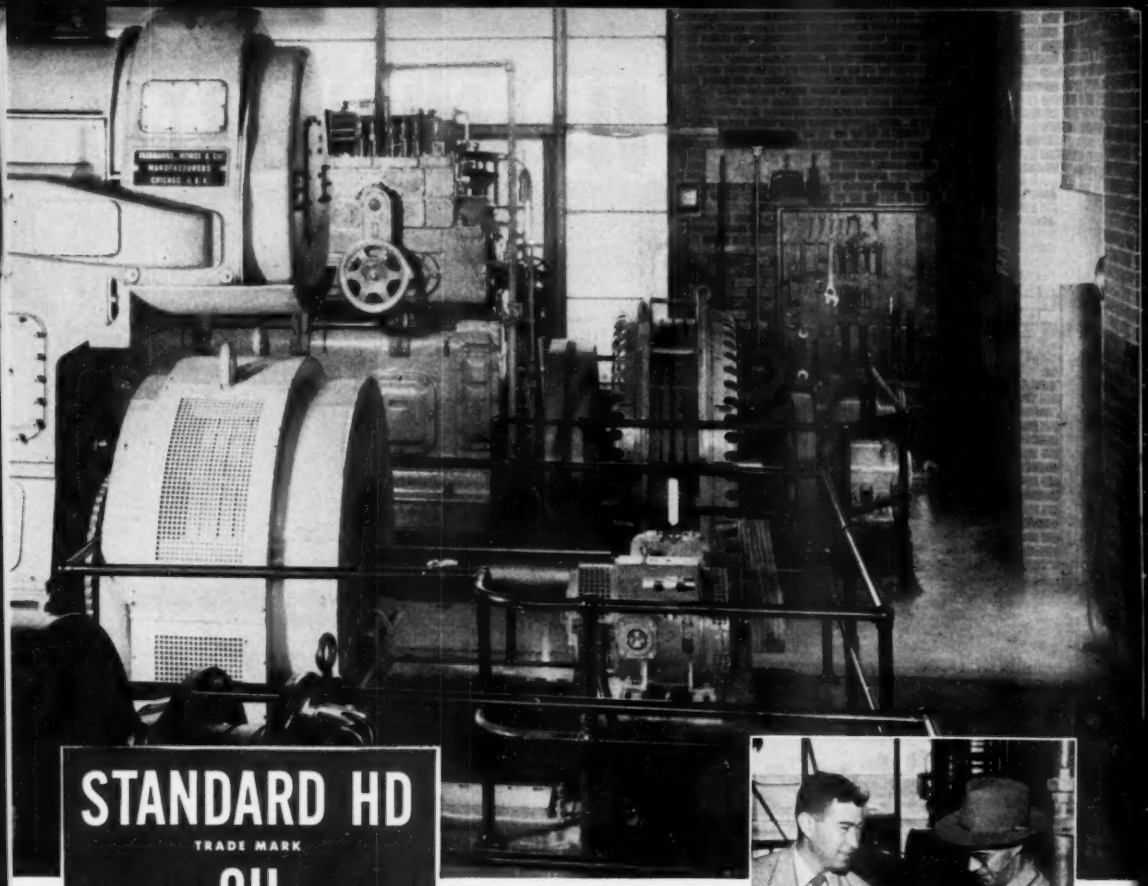
Keynote of Worthington's service reliability is the advantage you get because Worthington turbine generators are designed, assembled and tested for combined operation—as a complete unit—*before* shipment. Built in sizes up to 10,000 kw, the performance records of these machines are added proof that *there's more worth in Worthington*. For detailed information, consult your nearest Worthington representative or write to Worthington Corporation, Steam Turbine Division, Wellsville, New York. T.1.11

SINGLE-STAGE TURBINES | MULTI-STAGE TURBINES | TURBINE-GENERATOR SETS | FEED WATER HEATERS | BOILER FEED PUMPS | SURFACE CONDENSERS

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbine Generators



STANDARD HD
TRADE MARK
OIL

Solves a fuel problem...

● The Center Municipal Power Plant of Center, Colorado, had a unique fuel problem. Because of the plant's rather remote location in the Rocky Mountains, the cost of transporting diesel fuel to the plant was extremely high. Resourceful Mr. Vail F. Shumaker, superintendent, worked out a plan for utilizing locally produced crude oil as a fuel. The poor burning quality of this fuel, however, led to trouble. Fuel soot was heavy and deposits formed in the plant's four engines. Rings began sticking.

A Standard Oil lubrication specialist was asked for advice. Upon his suggestion, the conventional lubricant used in the diesels was replaced in one engine by STANDARD HD Oil, a truly heavy-duty lubricant containing necessary additives. During the next few months' operation, this engine alone remained clean. It was evidence enough. The other diesels were switched to STANDARD HD. Despite severe operating conditions imposed by the poor burning fuel, STANDARD HD has kept these engines clean and protected during three years of service. It has made possible the use of the locally available fuel and thus effected a sizable saving for this power plant.

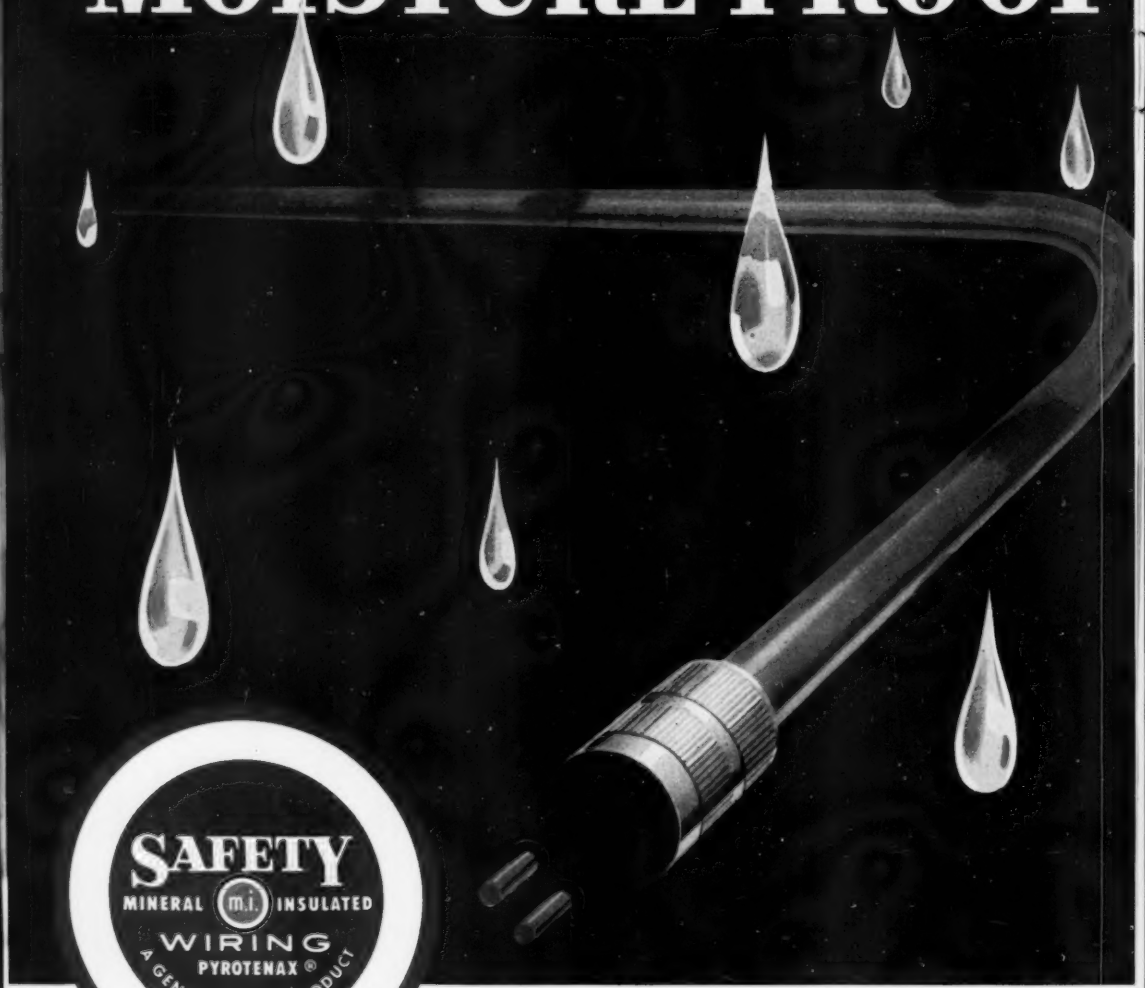
This plant's experience indicates how you can benefit through STANDARD HD and the services of a Standard Oil lubrication specialist. You can get those services easily and quickly by phoning your local Standard Oil (Indiana) office. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Pleased with performance of STANDARD HD oil are J. J. Tyler of Standard Oil (left) and Vail F. Shumaker, Superintendent of Center, Colorado, Municipal Power Plant, who worked closely together to solve a unique fuel-lubrication problem.

STANDARD OIL COMPANY

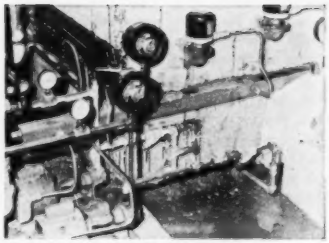
STANDARD *(Indiana)*

MOISTURE PROOF



SAFETY
MINERAL m.i. INSULATED
WIRING
PYROTENAX®
A GENERAL CABLE PRODUCT

SAFETY m.i. WIRING*
is available with
fittings to connect
to standard boxes
and equipment.



Being completely moisture-proof, Safety m.i. Wiring is ideal for installations in moisture-filled meat packing houses (shown left), and refrigeration plants.

*Exclusively a General Cable Product

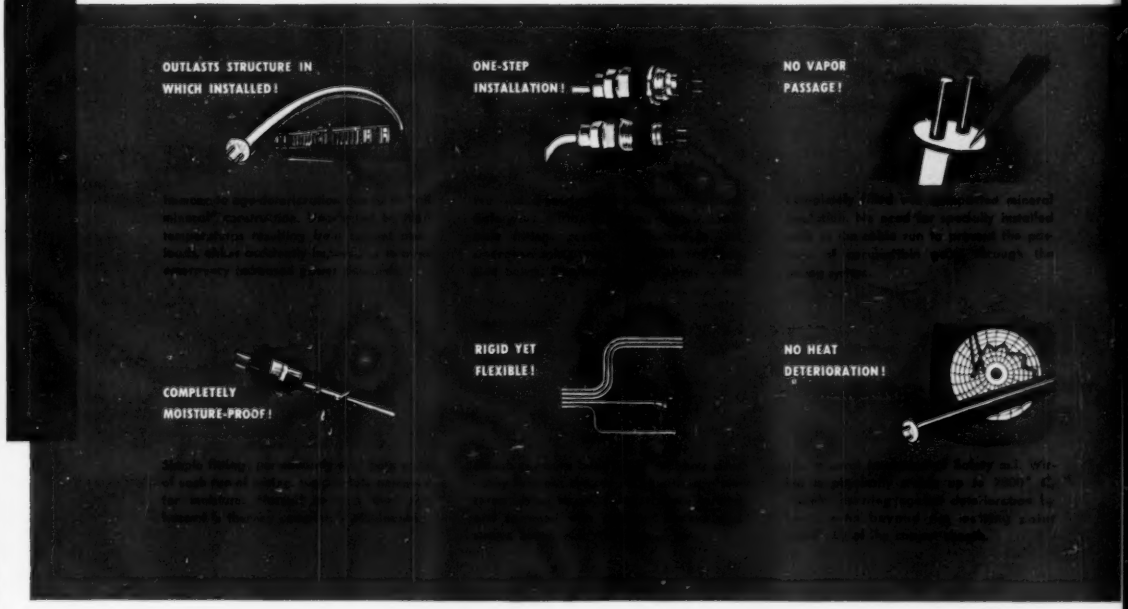
SAFETY m.i. WIRING

is completely impervious to moisture, oils, most acids and alkalies . . . and is unaffected by extremes of heat or cold

Sealed within a continuous copper sheath, the insulation of a Safety m.i. Wiring System affords complete immunity from deterioration in dielectric properties normally caused by the presence of gases, water, oil, solvents or accumulated condensation in confined spaces.

Self-protected, Safety m.i. Wiring offers important advantages beyond this sealed-in imperviousness—particularly in circuits where absolute protection from interruption is essential.

Briefly outlined here, these advantages will prove well worth your closer examination. Write today for our new brochure, "20 Questions & 20 Answers on Safety m.i. Wiring System".



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EXECUTIVE OFFICES: 420 LEXINGTON AVENUE, NEW YORK 17, SALES OFFICES IN PRINCIPAL CITIES OF THE UNITED STATES

"More Power to You"

GENERAL CABLE GENERAL CABLE GENERAL CABLE

why CRANE 600-pound small steel gates are sure to meet your needs

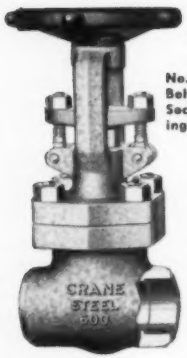
UNION BONNET GATE. Screwed ends. Sizes: ¼ to 2-inch. Available in three different trim materials for a wide range of services. Also with socket welding ends

You can't top these Crane Small Steel Gates for dependable performance on high pressure, high temperature lines . . . for ease of operation . . . for simplified maintenance. That's because they include design features normally found only in larger or more expensive valves.

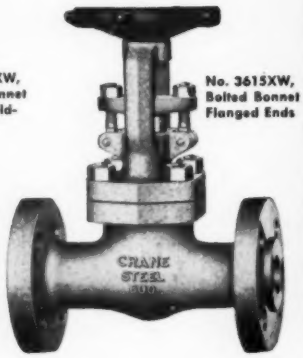
Then too, these Crane valves are available in a choice of types to meet your particular requirements. For example, with union or bolted bonnets; with screwed, flanged, or socket-welding ends; and in trim materials recommended for all common fluids.

GET NEW DESCRIPTIVE CIRCULAR AD-1881

For complete information—including prices—about these longer lasting, easier operating Crane Small Steel Gate Valves. Ask your Crane Representative for your copy, or write direct. No obligation.

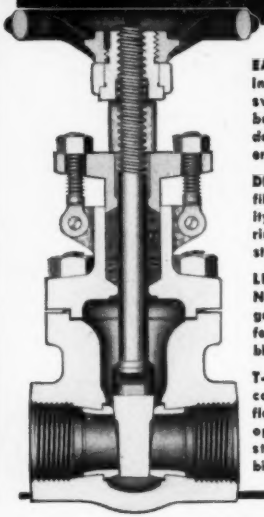


No. 3611XW, Bolted Bonnet Socket-Welding Ends



No. 3615XW, Bolted Bonnet Flanged Ends

Easy to Operate... Easy to Service



EASY ACCESS to stuffing box assured by swinging gland eyebolts. Improved yoke design provides liberal working space.

DEEP STUFFING BOX filled with high quality asbestos packing rings maintains tight stem seal.

LEAKPROOF BONNET JOINT. Soft iron gasket in male and female joint cannot blow out.

T-HEAD DISC-STEM connection provides flexibility for smooth operation; prevents stem distortion or binding of parts.

Cross-section No. 3607XW, Bolted Bonnet Gate, Screwed

CRANE CO.

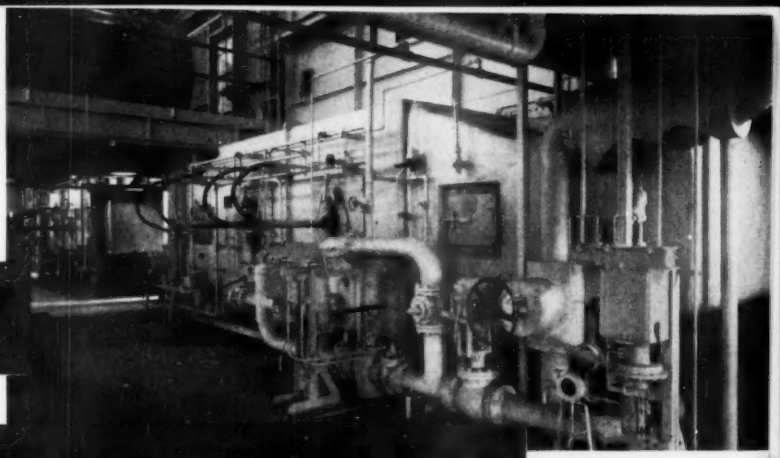
General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

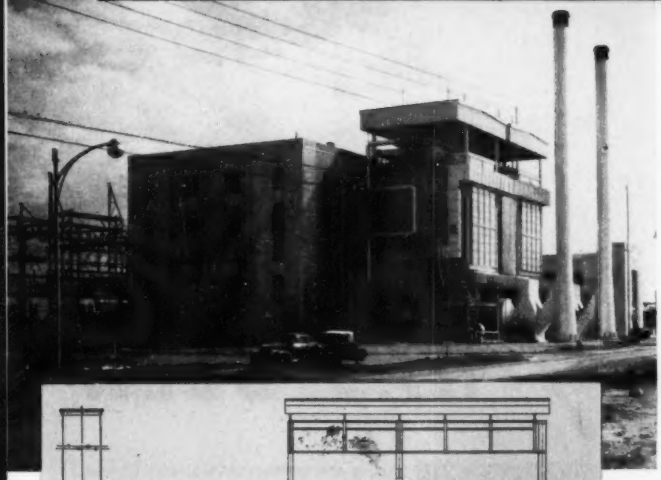
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

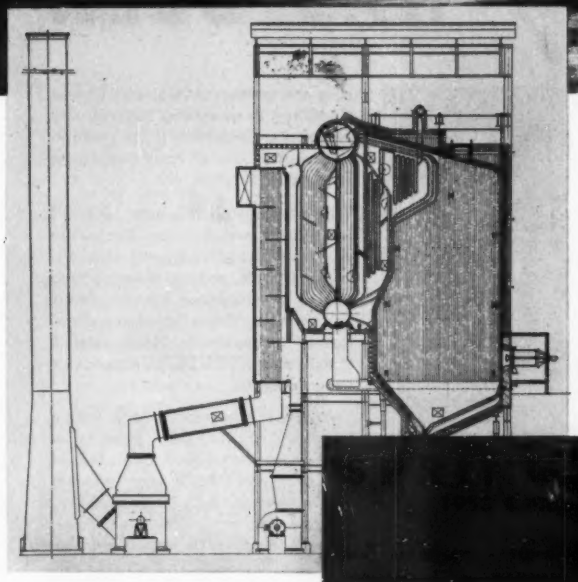
The W. R. (Bob) Poage Steam Plant, Belton, Texas, an outstanding example of modern, outdoor installation, features TWO Springfield Steam Generating Units. *Consulting Engineers:* Laramore and Douglass, Inc., Chicago, Illinois.

Right:—A view on the operating floor showing firing arrangement of Springfield Steam Generators.

Below:—The design cross-section.







. . . a story of multiple sales

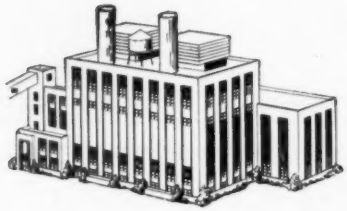
SPRINGFIELD Steam Generating Units combine modern design and efficiency with low initial and operating costs. That is why Springfield Boiler Co. enjoys so many repeat orders. For example, less than two years after the initial installation, this duplicate unit was added to the W. R. (Bob) Poage Steam Plant at Belton, Texas, to provide additional economical, trouble-free capacity.

Springfield specializes in the design and production of modern, efficient steam generating equipment—TAILORED TO SPECIFIC NEEDS—of size—pressure—temperature—and fuel. For economy, for ease of operation, for long, trouble-free service, write Springfield Boiler Co. today.

DESIGN DATA

Capacity	130,000 lbs. per hr.
Operating Pressure	630 psig
Total Steam Temperature	825°F.
Number of Drums	2
Type	Bent Tube
Fuel	Oil or Gas
Installation	Outdoors

WRITE FOR LITERATURE ON DESIGN AND INSTALLATIONS

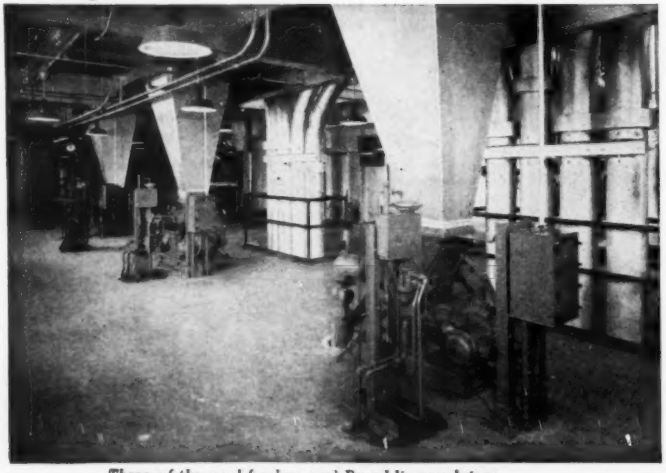


● at the New GADSDEN

Steam Plant of the

Alabama Power Company

Efficiency HAS BEEN



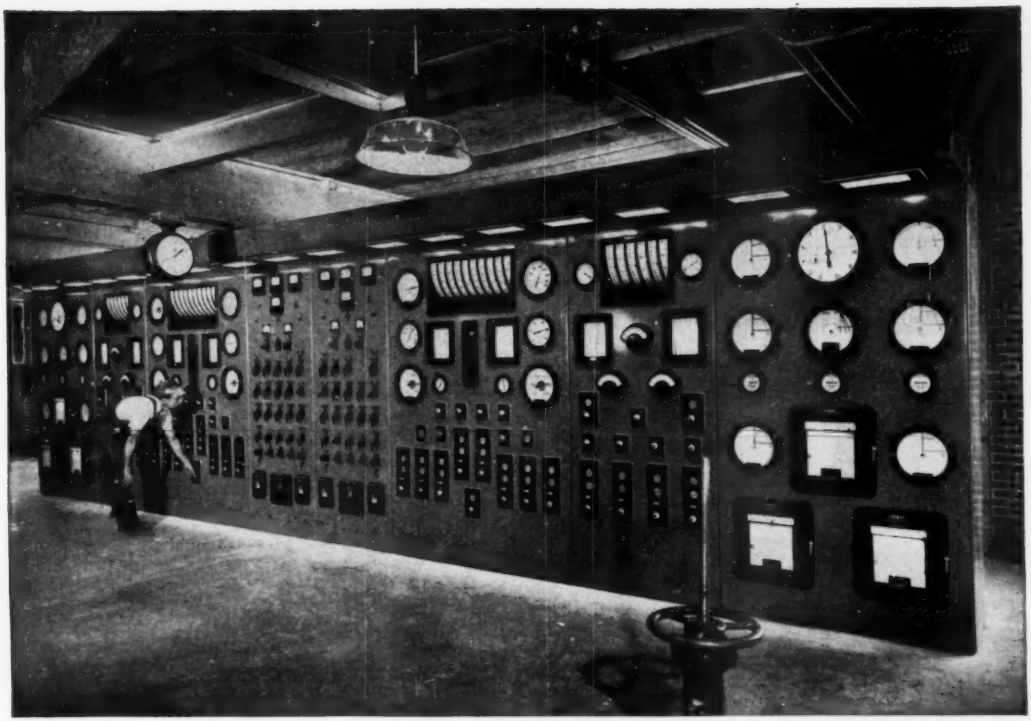
Three of the coal feeders and Republic regulators serving one of the boiler units.

It is the policy of Alabama Power Company to generate, transmit and distribute electricity to its customers at the lowest cost consistent with good service.

When designing the new 120,000 kw. Gadsden Steam Plant, the Alabama Power Company, in keeping with this policy, incorporated proven engineering developments which contribute to economical power generation. High among these was REPUBLIC automatic boiler control.

Two steam generators, each with a capacity of 600,000 pounds of steam per hour, and operated at 875 psig. and 885°F, supply steam to the two turbines. Fuels used are natural gas or pulverized coal, either singly, or in combinations.

The REPUBLIC control board is



On this Republic control board are mounted all gauges, meters and controls for operating each of the two boilers and their auxiliaries.

MADE *Automatic*

made up of one electrical panel, one recorder panel, and two combustion control panels per boiler. All panels are joined together to form one continuous board for the two boilers. The boilers are rubber mounted to reduce vibration, are gray in color, and lighted from an overhead canopy.

The REPUBLIC combustion control system receives its initial impulse from the main steam line through the master controller which establishes a pneumatic loading pressure proportional to the boiler load. The loading pressure is transmitted to the variable speed coal feeders, and to the gas flow valve when burning gas in combination with coal. This pressure is also transmitted to the air flow regulator. A corrector regulator provides means for maintaining the proper steam flow air flow relationship. Provision has also been made for manually adjusting this ratio from the boiler panel.

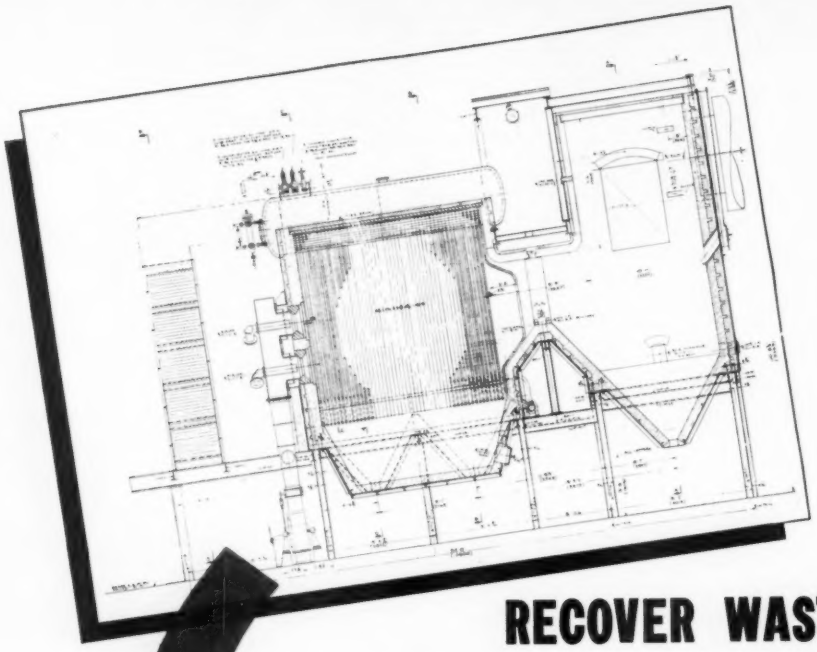
Air flow and furnace pressure are regulated by hydraulic coupling speed, but fan damper controls are provided for use at extremely low loads, when the fan speed would be reduced below 30% of the motor drive speed.

The boiler feedwater pumps are equipped with REPUBLIC automatic minimum flow hand reset valves. These valves open when the flow through the pumps is 150 gpm or less and by-pass this amount of water to the deaerating heater.

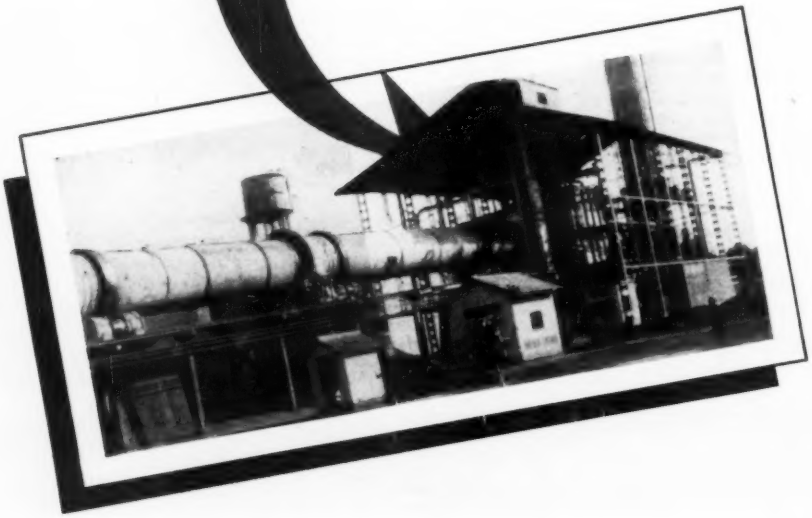
The REPUBLIC feedwater regulator is located on the operating floor and can be manually operated during emergencies from the boiler control panel. The valve control is pneumatic, single element, but the valve is operated by a hydraulic cylinder.

For complete information on REPUBLIC automatic boiler control write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. • 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



RECOVER WASTE
WASTE HEAT BOILERS



USABLE heat, ordinarily wasted at the end of the kiln shell, can be converted into steam for process or manufacturing. Save fuel . . . recover the lost heat that otherwise goes up the stack . . . turn it into FREE power!

Let KVS engineers design a waste heat boiler for your plant. Turn this unused, valuable heat into power for use in the manufacture of cement, lime, dolomite, etc. It's a sure and quick way to reduce your operating costs.

These highly efficient KVS waste heat boilers can be readily installed in any plant, old or new. They are a money-saving, money-making investment that pays big dividends, consistently and immediately.

HEAT WITH KVS FOR FREE POWER!

A typical KVS Waste Heat Boiler under construction, viewed from the economizer end.

Consult our engineering department for details, specifications and operating data.

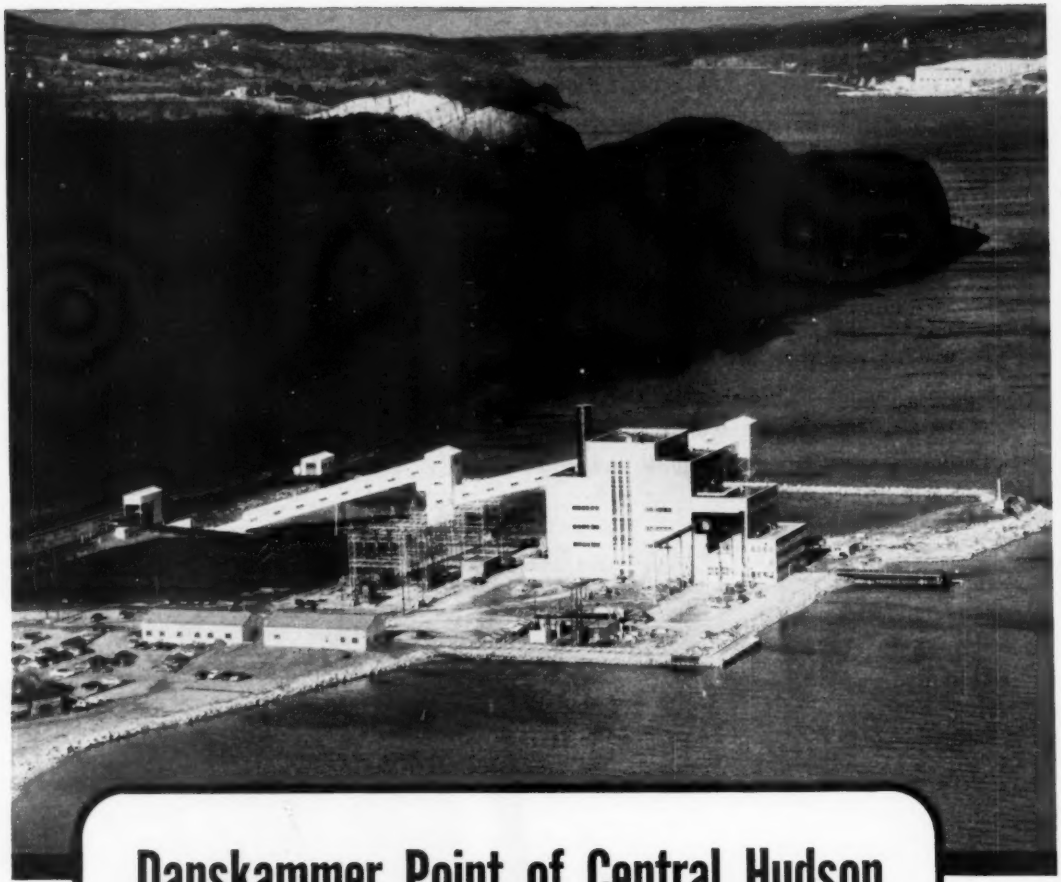
IT COSTS LESS.. TO OWN THE BEST!

KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK

FACTORY DANVILLE, PA.

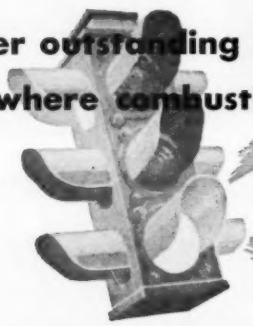


Danskammer Point of Central Hudson

"The New Look in the Hudson River Valley"

Engineered by
Burns & Roe, Inc.

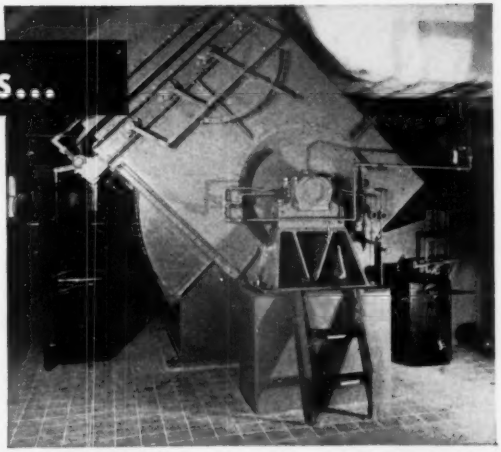
Another outstanding steam generating plant where combustion air and gases



GO on GREEN

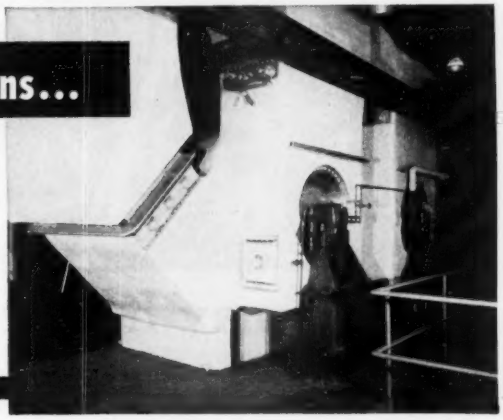
Two Green Forced Draft Fans...

operating in parallel on one boiler; each is designed to deliver 75,000 cfm of air at 125°F against 12.5 inches static pressure while running at 1175 rpm; special control type inlet dampers; standard control type outlet dampers; constant speed motor.



Two Green Induced Draft Fans...

operating in parallel on the same boiler as the F.D. Fans, each is designed to handle 126,000 cfm of gas at 335°F against 17 inches static pressure while running at 850 rpm; shut-off dampers at inlet and outlet; gyrol fluid drive.



Danskammer Point Station of Central Hudson Gas & Electric Corporation, has the reputation of being one of the most efficient plants in the country, with a fuel record of less than 8/10 pounds of coal per kw. These four Green Fans, because of their design efficiency and careful construction, are playing an important part in this production record. And the service they are giving is being duplicated in many utility and industrial steam generating plants throughout the country. In keeping with the requirements of dependable service, such plants "Go on Green" fans.

Send for our Fan Bulletin 168. If interested in Green Economizers, send for Bulletin 169.

The Green Fuel Economizer Company, Inc.

BEACON 3 **NEW YORK**

Economizers · Fans · Air Heaters · Cindertraps · Aerodyne Dust Collectors

"You may have to stand outside!"

REMEMBER Aesop's fable of the camel and his master--how the kind master allowed the shivering beast to put into the tent first his head, next his shoulders, then his forelegs!

And then the camel said, "Master, I think I ought to come wholly inside," and crowded in. Immediately he said, "There is hardly room for us both, so I think it would be better for you to stand outside so I can turn around and lie down." And without further ado, the camel kicked the man out and took the entire tent.

Men have heard this story for 2,500 years--repeatedly have seen how it illustrates what happens when one man or group of men gain power over others. Men saw it happen in Italy and Germany when Mussolini and Hitler took over. Men saw it happen in Russia.

Even here in America a similar trend is evident. Powerful influences overlook no opportunity, through political manipulation, central controls and bureaucratic regulations, to intrude more and more in our private lives. The situation demands continual, alert watchfulness by all citizens who believe in individual liberty and freedom, to prevent this camel of big government from creeping further into the tent. Before we realize it, "we, the people," the master, may find ourselves "standing outside." In America it is government, which is the servant of the people.

YOUR SCRAP IS NEEDED — YOUNGSTOWN

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

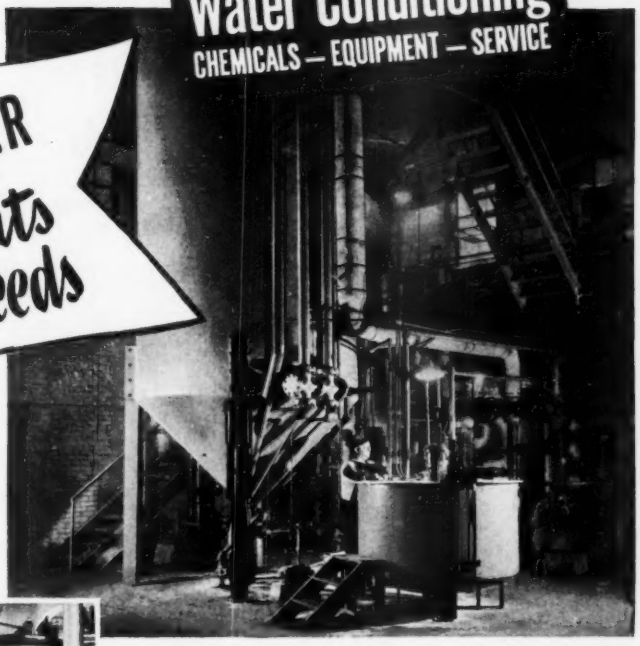
The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment

ALLIS-CHALMERS

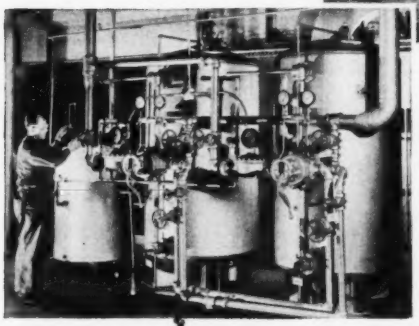
Water Conditioning

CHEMICALS — EQUIPMENT — SERVICE

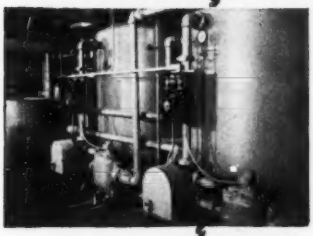
FOR WATER that Fits Your Needs



This hot process lime-soda softener for treating makeup to high-pressure boilers is rated at 5000 gph.



Sodium zeolite water conditioning equipment with capacity of 130 gpm provides boiler makeup to evaporator in an eastern utility power plant.



Dual automatic sodium zeolite water softener rated at 225 gpm is used in power plant of a Texas hospital.

TO ASSURE YOU water conditioned to your specific requirements, A-C engineers can draw on years of experience treating all types of water . . . plus a broad background of building turbines and processing equipment that are dependent on properly treated water. A-C water conditioning service includes:

Chemicals — for external and internal boiler water treatment . . . designed for silica removal and control of scale, corrosion and carryover. Also cooling cycle treatments . . . and dependable reagent chemicals.

Equipment — hot and cold process softeners . . . sodium and hydrogen zeolite softeners . . . alkalinity-reducing ion exchangers . . . deionizers . . . degasifiers . . . deaerating heaters . . . chemical feeding equipment . . . pumps . . . oil removal and water filters.

Comprehensive consultant service — surveys, reports . . . chemical and X-ray analysis . . . special studies.

WRITE FOR THESE BULLETINS

28X7636 — Meaning, Application and Measurement of pH

28X7559 — Hot Process — Hot Zeolite System

2886611 — Hot Process Softener

2887107 — Sodium Zeolite Softener

28X7808 — Alkalinity-Reducing Ion Exchanger

ALLIS-CHALMERS

A-3827

Milwaukee 1, Wisconsin

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

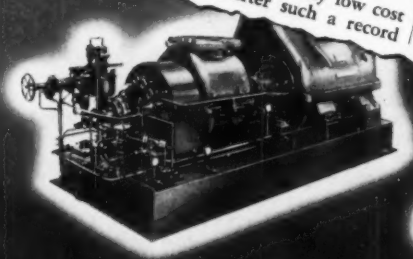
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

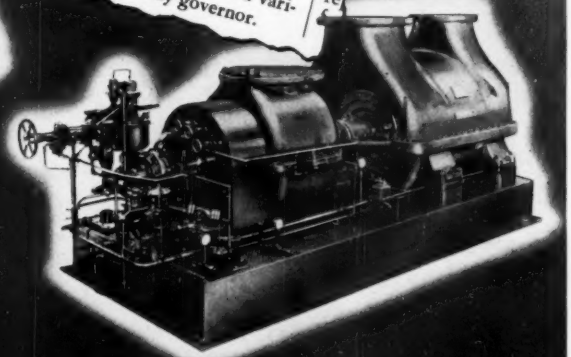
Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.





For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1193

What's the $ Connection?

If there's a furnace operation in your setup . . . there's a mighty big connection between the CITIES SERVICE HEAT PROVER and your profit and loss picture.

Heat Prover—not an instrument you buy, but a service we supply—helps to increase furnace productivity through these five unique advantages:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

ACCURATE, FAST CITIES SERVICE HEAT PROVER ANALYSIS CAN PUT THE FINGER ON WASTE IN YOUR FURNACE OPERATION. It's being widely used in a great variety of industries. Find out how Heat Prover can serve you. Write Cities Service Oil Company, Dept. H22, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

POWERHOUSE PUMPS

Use This Pump Laboratory

TO STUDY ACTUAL SUCTION CONDITIONS BEFORE CONSTRUCTION STARTS

CORRECTING PUMP SUCTION CONDITIONS after your powerhouse is built can be mighty expensive. You can avoid this danger by testing your suction bay design in this Allis-Chalmers test laboratory.

This unit will duplicate the shape and water flow conditions of your suction bay and show you just how your circulating pumps will operate after installation. You can experiment with the shape and size of the suction bay, test various positions for foundations and pilings, check the effect of adding more pumps at a later date, plot operating characteristics at various loads; in fact, duplicate almost any suction condition that you may encounter in your plant.

Available to Consulting Engineers and Power Plant Operators

The pump testing facilities of the Allis-Chalmers research laboratories are available at the West Allis, Wisconsin, Works to all consulting engineers, utilities and power plant operators concerned with large pump operation. If this pump testing laboratory can help you, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis.

A-3782

ALLIS-CHALMERS

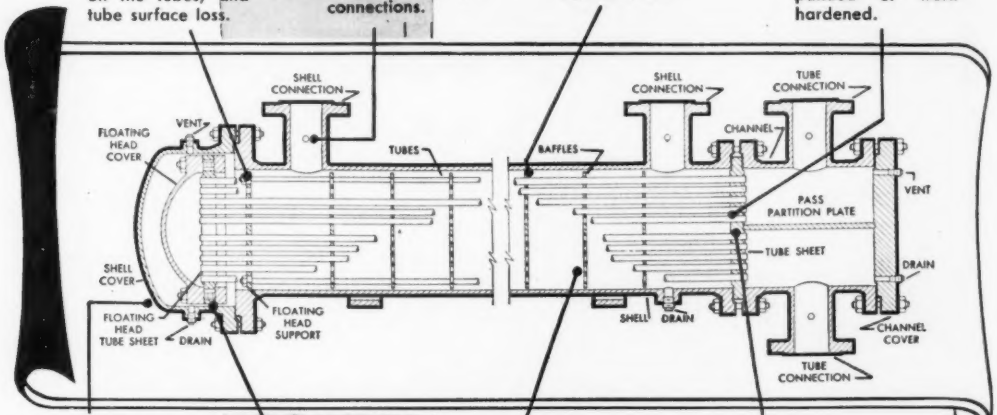
HEAT EXCHANGER EFFICIENCY starts with SUPERIOR DESIGN

"Do-Nut" shape support plate offers maximum support to the floating head without undue strain on the tubes, and tube surface loss.

Connection for pressure gauge and thermometer provided on all flanged connections.

Baffles — cross flow segmental type machine cut and drilled. Close tolerances assure maximum heat transfer.

Tubes — expanded into tube sheets by means of electronic controlled roller expanders, tubes cannot be over expanded or work hardened.



Removable shell cover for easy access to floating head.

"Knock-down" Type floating head. Use of floating head minimizes thermal expansion strains.

All baffles exactly spaced and solidly bolted together with heavy tie rods and spacers.

Ample thickness tube sheet to prevent undue deflection at pass partition plate.

The features of design which make a heat exchanger *good* are the features which contribute most to efficient, long-lived, trouble-free performance *under your operating conditions*. Since operating conditions are seldom exactly duplicated, industrial heat exchangers are usually custom-built . . . and design characteristics are different for each application.

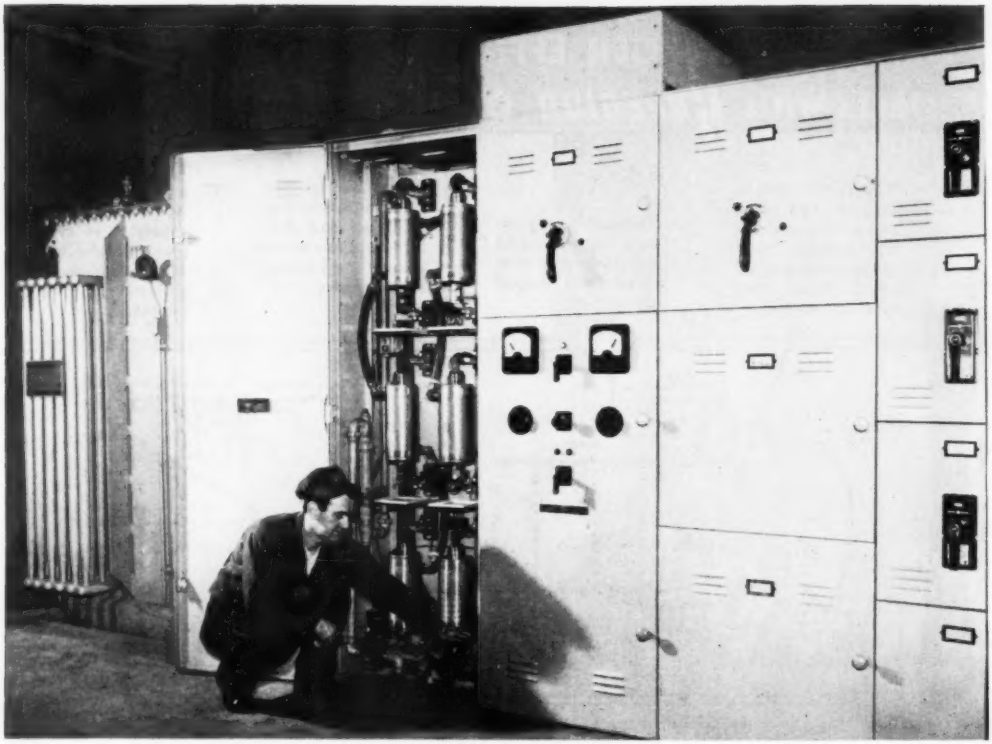
But while design characteristics differ, the fundamentals of good heat exchanger construction never change. If you are considering the purchase of heat exchanger equipment, we welcome the opportunity of showing you how SUPERIOR Heat Exchangers combine tested fundamentals with design features that fit your use . . . for performance you can BANK on.

Write for your copy of catalog 501

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
HEAT EXCHANGERS



THIS G-E RECTIFIER AT ALLIANCE HAS REQUIRED NO MAINTENANCE SINCE INSTALLATION IN 1950.

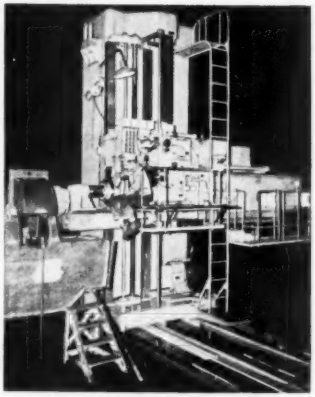
Producer of world's largest cranes uses 300-kw rectifiers for DC power

Alliance Machine Co. gains higher line efficiencies by using General Electric Ignitron Power Rectifiers

In the manufacture of mammoth cranes and other heavy factory equipment, the Alliance Machine Company, Alliance, Ohio, depends on the d-c power from its G-E Ignitron Rectifiers to run hundreds of machine tools throughout the plant.

Installed late in 1950, the mercury arc rectifiers have been in service ever since, requiring no maintenance, with not even a tube needing replacement.

The G-E Ignitron Rectifiers, such as those at Alliance, operate 24 hours a day, 7 days a week. Supplied as a complete packaged unit with transformer and metal-enclosed switchgear, the installation occupies minimum space. For information on a G-E Ignitron Rectifier to fit your d-c power needs, call or write your nearest G-E sales office. General Electric Company, Schenectady 5, N. Y. 324-7



This giant boring mill operates on d-c power supplied by the 300-kw G-E Ignitron Rectifiers at Alliance.

GENERAL ELECTRIC

You get more than just a valve—when you specify POWELL
Here is what you get: First, a valve of finest quality materials and workmanship. Second, a valve that is exactly suited to the actual service conditions. And, third, the help of Powell Engineers in determining the right valve to solve any flow control problem you may encounter.
There are more specifically adapted Powell Valves in use today than any other make.
The Wm. Powell Co.
Cincinnati 22, Ohio
Fig. 11303 W. E. 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends. One of many Powell designs for Power Plants
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

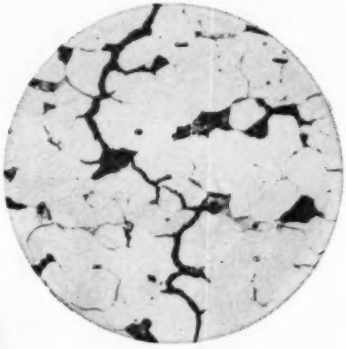
TECHNICAL SERVICE for your plant water problems

Hall Laboratories' specialist studies a specimen on a metallographic microscope. This modern instrument is an example of the equipment Hall Laboratories utilizes in seeking the answers to your plant water problems.

The metallographer focusing this precision microscope-camera is taking one step toward solving a plant water problem. The structure of damaged metal often is an important factor in determining the cause of failure or poor performance. Stress-corrosion, caustic embrittlement and overheating can be detected by this method. The evidence, in conjunction with Hall Laboratories' other modern techniques, helps clients solve industrial water problems.

You can profit by Hall Laboratories' wide experience and modern equipment. Every phase of the use and disposal of industrial water is included in the scope of Hall Service and facilities for all industries —metal, paper, power, chemical, for example.

For information pertaining to your particular Industrial Water problems, write, wire, or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.



Photomicrograph of the typical intergranular cracking of caustic embrittlement. The metal was damaged by concentration of alkaline boiler water at a leaky tube end.

S-A CONVEYING Systems

Speed Coal Handling
...INCREASE Efficiency
...DECREASE Costs

This coal handling system receives coal from a large track hopper and from a ground storage area. A pan feeder feeds coal to an S-A Knittel ring-type crusher. Crushed coal then travels on long, inclined belt conveyors to boiler plant. Another belt conveyor in the plant distributes coal to storage bunkers. By-pass chute, at transfer point, diverts excess coal to outdoor stockpile, from where it can be reclaimed as needed.

Belt Conveyors
REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Weigh Larries
Crushers, Roll & Ring Type
Bucket Elevators
Gravity Discharge Conveyors
Screw Conveyors
Skip Hoists
Belt, Pan & Plate Feeders
Track Hoppers & Bin Gates
TELLEVEL Bin Level Controls
Water Intake Screens
SEALMASTER Ball Bearing Units

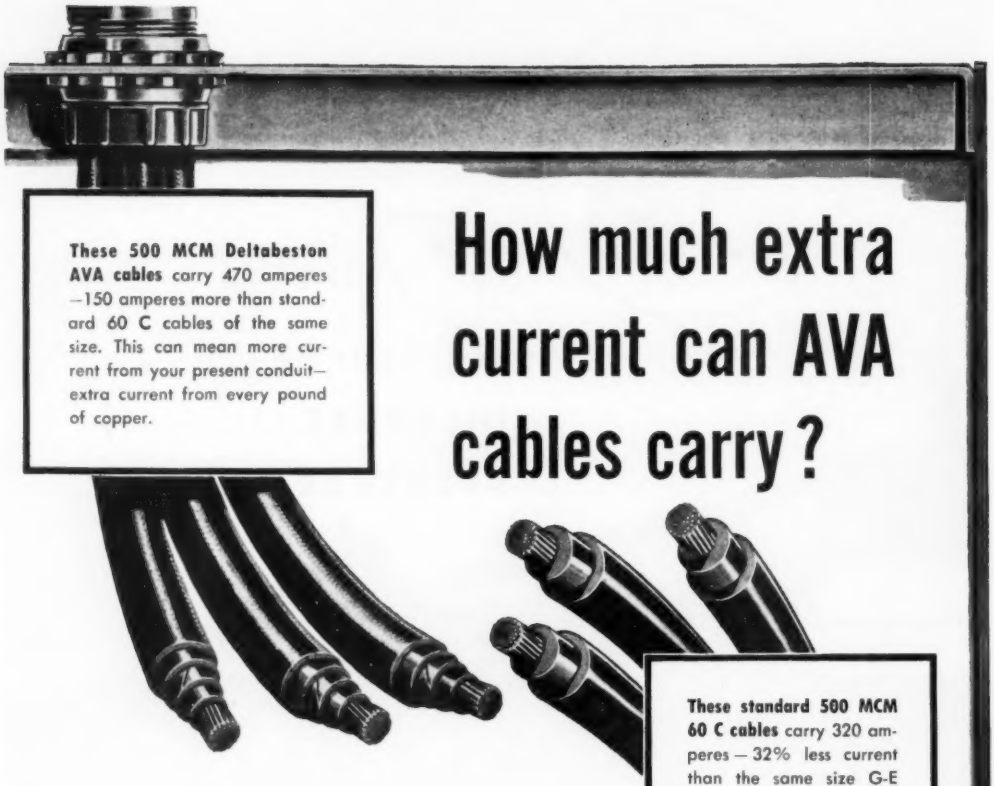
Write for a bulletin on any of the above

When it comes to moving coal, many of the largest concerns in the U.S.A. have come to S-A—for advice, for plans, for equipment and installation. This has been going on for years! And successfully for all concerned. And so, we don't hesitate to ask YOU to put your material handling problems up to us. We believe —and experience proves—we'll come up with the *right* answer—the answer which will save you time, trouble and money!

STEPHEN S-A ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



These 500 MCM Deltabeston AVA cables carry 470 amperes—150 amperes more than standard 60 C cables of the same size. This can mean more current from your present conduit—extra current from every pound of copper.

How much extra current can AVA cables carry?

These standard 500 MCM 60 C cables carry 320 amperes—32% less current than the same size G-E Deltabeston* AVA cables. Deltabeston cables permit operation at increased temperatures—offer more current per pound of copper.

If you're planning new distribution or changes in your existing wiring system, it will pay you to look into the savings of G-E Deltabeston AVA cable. Deltabeston can actually offer as much as 64% more current from your present raceways—can offer more current in most wire sizes.

Famous G-E No. 1799 varnished cambric and double-asbestos insulation make Deltabeston suitable for operation at high temperature. That's why *at normal ambient temperatures* it can handle more current than ordinary types.

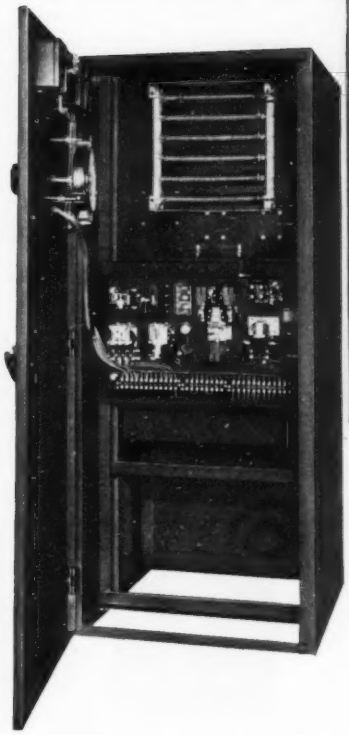
Before you wire or re-wire, check Deltabeston AVA cable. For information get in touch with your local G-E Construction Materials distributor, or write Section W24-863, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

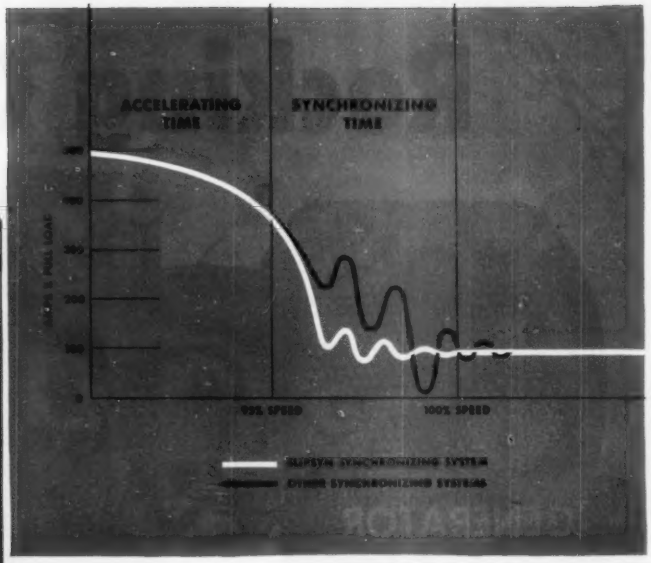
** Registered Trade-mark of General Electric Company*

Deltabeston
WIRES and CABLES
Built to beat the heat

You can put your confidence in—

GENERAL ELECTRIC





No synchronization "Bump" when Slipsyn does the timing

Slipsyn* starters excite the field at the right time, at the right polarity . . . let your motors reach synchronization smoothly—properly.

The ASR relay, brain of the dependable Slipsyn starter, calls the signals. It measures motor speed electrically—exactly, by timing slip frequency of the induced field current. What's more, the ASR relay spots the proper rotor angle for maximum pull-in torque and minimum line disturbance. At precisely the right speed and rotor angle, the ASR relay permits the field to be excited. The result? Smooth synchronization . . . peak motor performance.

ASR relays are simple in design, rugged in construction. They're easily set for best operating conditions of your motor. Turn an adjusting nut and the relay's set!

Slipsyn starters do a protective job, too. Pull-out relays can be made to either shut down the motor if it pulls out of synchronization, or initiate a re-synchronizing sequence. Damper windings are protected by relay against burnout. Thermal overload relays guard motor against damage from overload, single-phase operation and field failure.

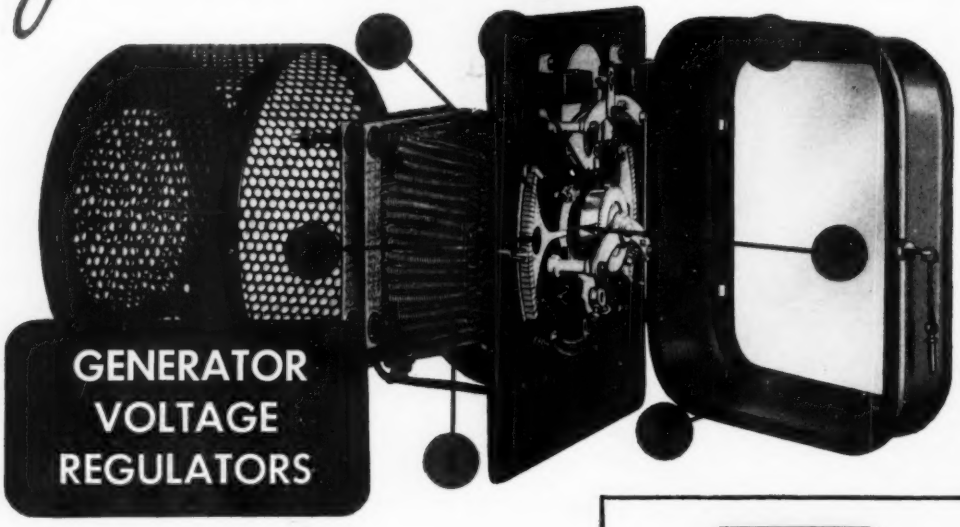
Yes, through every phase of synchronous motor operation, Slipsyn starters do a precise, dependable, protective job. For full information, call your local Westinghouse representative or write, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-27031

*Trade-mark

YOU CAN BE SURE...IF IT'S
Westinghouse

SLIPSYN
SYNCHRONOUS MOTOR CONTROL

Get Rocking Contact



GENERATOR VOLTAGE REGULATORS

With these 7 Features:

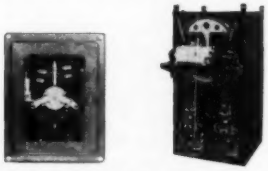
- **RESISTORS** are matched to the characteristics of your machine . . . are cut in and out of the exciter shunt field by the *Rocking Contact* sector.
- **SECTOR RIM,** of hard graphite, rocks on the silver-surfaced commutator. This eliminates contact build-up without polarity reversing circuits.
- **COMMUTATOR** is curved so that small sector movement gives quick response.
- **MOTIVE ELEMENT** driving contact sector is fast acting—because of its low inertia design.
- **DAMPING MECHANISM** has no electrical circuits . . . is self-contained.
- **JEWELED BEARINGS** reduce friction, improve sensitivity.
- **DUST-TIGHT COVER** seals out dirt . . . assures lasting accuracy.

Designed for panel mounting, every *Rocking Contact* Regulator has an instrument-like appearance. Select the one that fits your needs. For further information, call your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3762

Rocking Contact is an Allis-Chalmers trademark.

TYPES A, B, and C (shown in detail above) are applied to ac generators from 125 kva at 257 rpm to 25,000 kva at 3600 rpm. Get Bulletin 1486035.

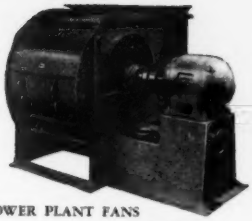
TYPES V-00 and 221 Regulators are applied to ac generators from the smallest up to 438 kva at 3600 rpm. Bulletin 1486143A describes them.



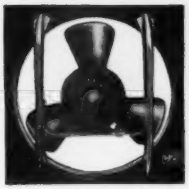
TYPE J, for larger machines, consists of two parts: motor-operated *Rocking Contact* rheostat and a panel-mounted control element. Bulletin 1486015.

ALLIS-CHALMERS

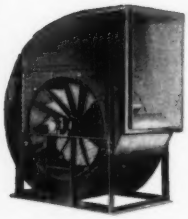
AXIAL FLOW FANS



POWER PLANT FANS



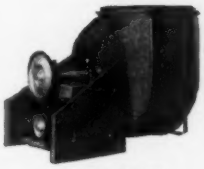
BREEZO FANS



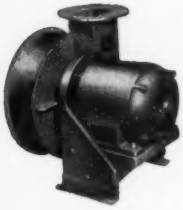
LIMIT-LOAD FANS

75 years of building dependable air handling equipment

VOLUME FANS

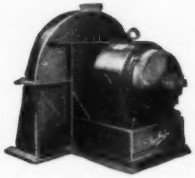


BELTED VENT SETS



TYPE "CB" PRESSURE BLOWERS

RE BLOWERS-EXHAUSTERS



TYPE "CC" PRESSURE BLOWER

Efficient Air Handling Units
To Satisfied Customers
Since 1877

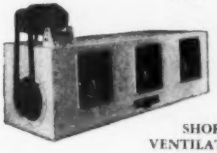
We welcome the opportunity to solve *your* problem.

BELT AIR FANS

BABY CONOIDAL FANS

INDUSTRIAL EXHAUSTERS

"E" BLOWERS-EXHAUSTERS



SHORTBOY VENTILATING SETS

DIAMOND JUBILEE 75TH ANNIVERSARY

"Buffalo" FIRST FOR FANS

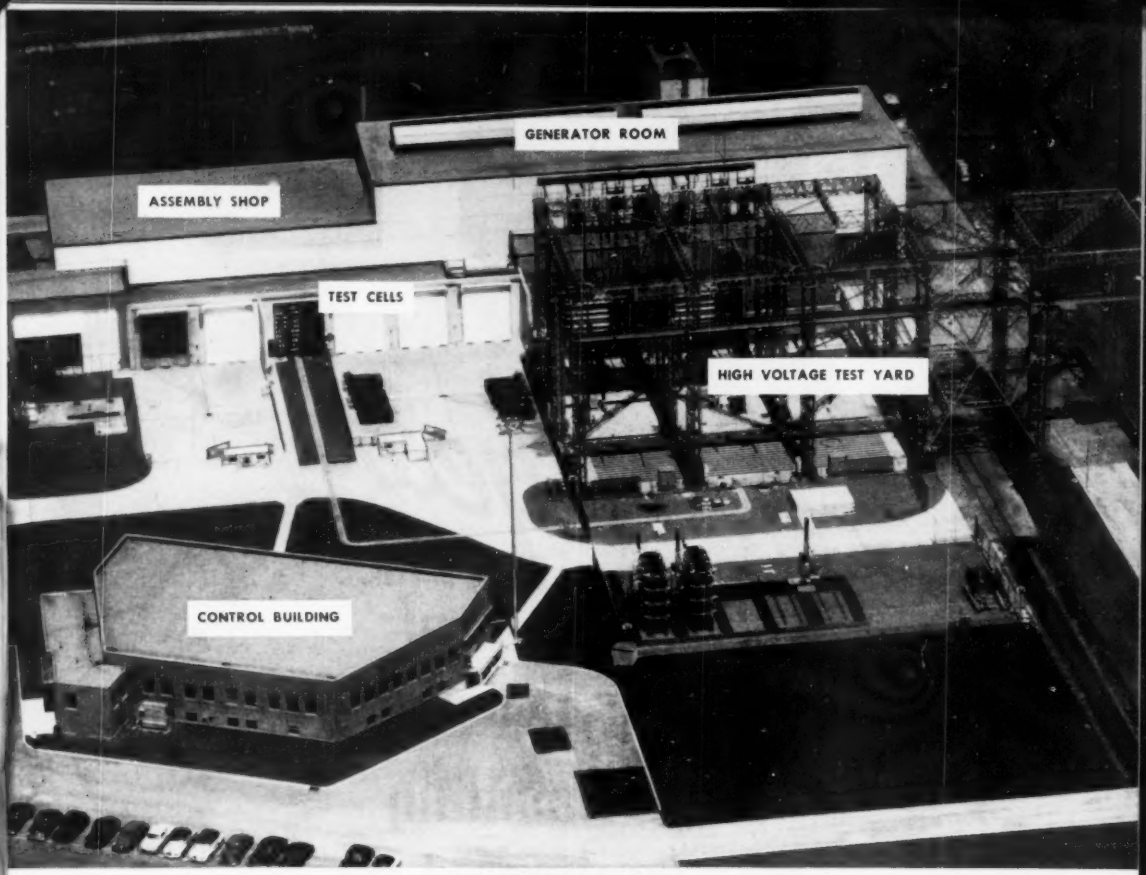
BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING | PRESSURE BLOWING | AIR CLEANING | COOLING | AIR TEMPERING | HEATING | INDUCED DRAFT | FORCED DRAFT | EXHAUSTING



GENERAL ELECTRIC'S NEW SWITCHGEAR DEVELOPMENT LABORATORY

New Multimillion-kva "Fact-finder" for Development of Tomorrow's Switchgear

Switchgear Development Laboratory has world's highest capacity testing facilities

American industry—now in the midst of its third and greatest expansion—depends more and more on dependable power equipment to help achieve present and future production goals.

To assure the best in proof-tested switchgear, General Electric has opened at Philadelphia this new switchgear development laboratory—a multimillion-kva "fact-finder" equipped to develop and test the switchgear needed for tomorrow's vastly increased industrial power load.

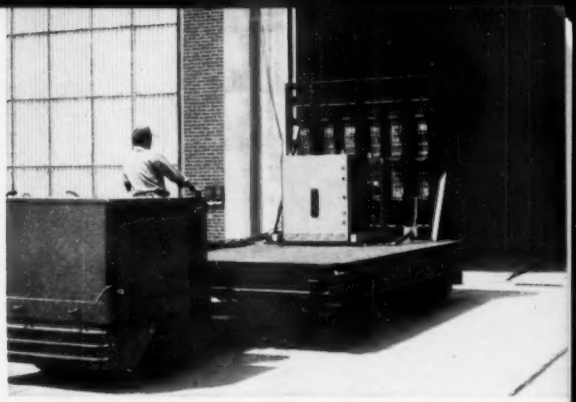
In two previous switchgear laboratories, General Electric has made over 300,000 tests which have played a large part in the development of modern switchgear. In this new development laboratory, General Electric has facilities for faster and higher-capacity tests than were ever before possible.

The new development laboratory is already at work proving the reliability of higher-capacity G-E switchgear that will handle rapidly increasing industrial loads and prevent power distribution failures and resulting work stoppages in your plant.

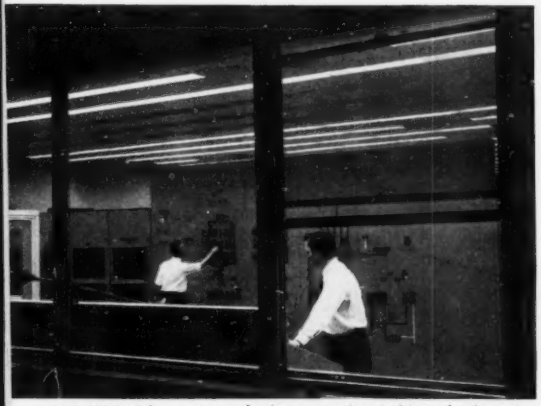
Because of the speed, accuracy, and increased number of tests possible, G-E's multimillion-kva "fact-finder" will make a great contribution to the design, development and testing of apparatus with higher voltage and interrupting capacity for the industrial loads of tomorrow. General Electric Co., Schenectady 5, N. Y.

854-50

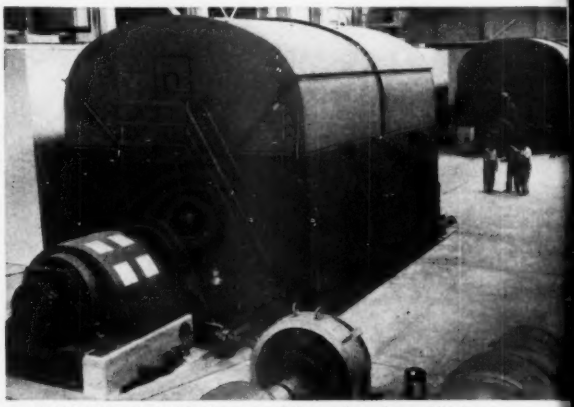
IN CONTROL BUILDING, engineers analyze test data on film two minutes after test. In background, with view of test area, operator at benchboard prepares to control next test.



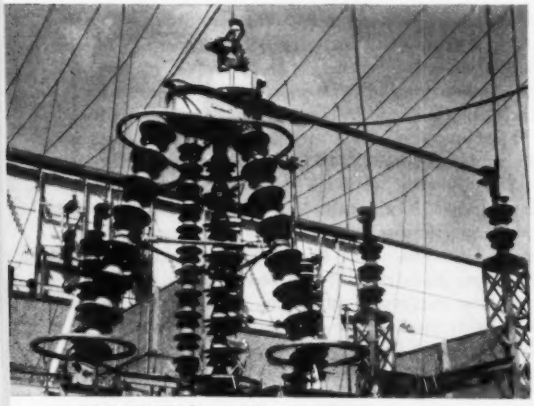
SPECIAL TEST CARS quickly transport equipment prepared for test in assembly shop. When car rolls into test cell, equipment it carries is automatically connected in test circuit.



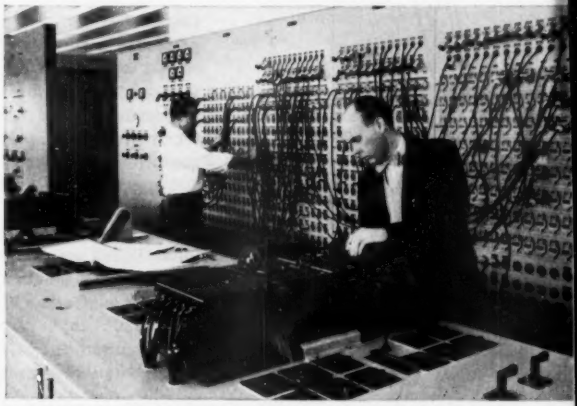
TEST CIRCUIT is set up on duplex control switchboard where bus diagram and indicating lights help engineers visualize entire test. Switchboard is easily seen from operating benchboard.



GIANT TESTING GENERATORS are used in conjunction with three step-down transformers for high-current testing, and with two step-up transformers for high-voltage testing.



A MOTOR DRIVEN, five-position tap selector switch automatically makes tap selection on high-voltage transformers located between the high-voltage test yard and the main test building.



11-ELEMENT MAGNETIC OSCILLOGRAPHS in control building and cathode ray oscillographs in test area record test data on films which can be analyzed two minutes after test is completed.

GENERAL ELECTRIC

FOR GASKETS THAT WON'T LET GO

On shipboard . . . in power plants . . . wherever high temperatures and high pressures are involved . . . gasket failure is a matter of grave concern. It often causes widespread damage and can also mean danger to personnel. Measuring this cost and the loss of production time has led many plants, refineries and shipyards to standardize on Flexitallic Spiral-Wound Gaskets, the gaskets that won't "let go" . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a pre-determined load. For all pressure/temperature ranges from vacuum to 6000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Co., 8th & Bailey Sts., Camden 2, N.J. Representatives in principal cities. Consult your Classified Telephone Directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* in gaskets with asbestos filler.

The Power Engineer's Job

DESPITE CONSTANT PROGRESS in technical content, and in the journalistic art of getting out a magazine, POWER's concept of its field has never varied in any fundamental way for many décades. The time has come to restate this concept so all readers may know exactly what service we aim to render.

First, speaking broadly, we aim to serve all who are, in fact, responsible power engineers, whatever their title may be. This term embraces those who design and build power plants, as well as those who operate and maintain them.

What is a power plant? In the case of central power, the "plant" is just what everybody thinks it is, the generating station. POWER is concerned with everything that takes place within its walls.

Where does POWER stand in industry generally? Here it is important to distinguish sharply between "power house" and "power plant." In industry we are concerned with the power plant, of which the power house—"the building with the smokestack," is only a part.

The industrial power plant, as we understand the term, includes all equipment used in industry to generate, transmit and apply all the power services. These services are all those fluid forms of energy that can be turned on and off at will. They are best pictured in terms of the means of their transmission. Thus, wires carry the electrical service. Shafts, belts and gears transmit mechanical power. Pipes and ducts carry steam service, hot and cold water, refrigeration, compressed air, heating, ventilation and conditioned air.

At the supply end of these services we see, for electricity, either generators or a transformer station, or both. Steam service is generated by boilers. Mechanical power is generated by engines, turbines or water wheels. Cold-water service is "generated" by pumps, converted to hot-water service by steam-fed heaters; refrigeration and compressed air by compressors; heating and air conditioning by fans, heaters, cooling coils, etc.

Major equipment items for power-service transmission include piping, valves, fittings, insulation, duct work, traps, instruments, controls, wiring, transformers, switchgear, shafting, belts, gearing, etc.

At the application end we have motors, devices operated by water and compressed air, unit heaters, and still more switchgear, valves, traps, instruments and controls.

In every industry everywhere, including large buildings and institutions, this complete system of power-service equipment is what POWER has been talking about month after month for many decades. To us this is the "power plant." If you prefer another name you can call it the "power-service system."

POWER's purpose in dealing with so many power services is not merely ambition to "cover the water front." Rather, it is to give the power engineer a unified technical service fitted to the very nature of his job. Everywhere you look the power services have become a single responsibility because they cannot be successfully separated in their top management; they are all of a piece, intertwining endlessly.

To sum up, POWER's job in industry is to give a complete service to the power engineer, a service that covers all phases of the design, construction, operation and maintenance of the industrial power-service system. This system includes all equipment involved in the generation, transmission and application of the power services. The power services are steam, electricity, mechanical power, hot and cold water, refrigeration, compressed air, heating and air conditioning.

350,000

HORSEPOWER

supplied by 194 NORDBERG GAS BURNING RADIAL ENGINES

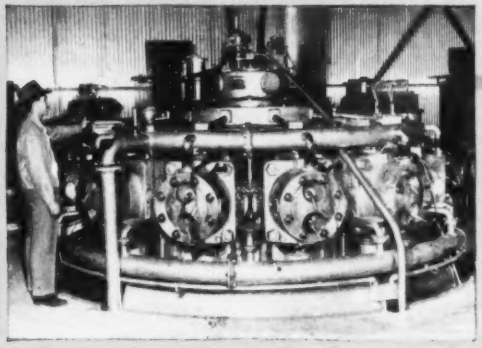
makes ALCOA'S Point Comfort Reduction Works the WORLD'S LARGEST Internal Combustion Engine Power Plant

★ A seventy per cent increase in aluminum smelting capacity at Aluminum Company of America's Point Comfort (Texas) Works has been made possible through the installation of seventy-four additional Nordberg spark-fired gas burning Radial Engines.

This power, added to that generated by the original 120 Nordberg spark-fired gas burning Radial Engines placed in operation in January, 1950, gives the Alcoa plant a total of nearly 350,000 horsepower—*by far the world's largest internal combustion engine station.*

Here, then, is another excellent example of the way in which Nordberg Diesel Engines, in sizes from 10 to over 10,000 hp in single units, are used to provide dependable, economical power for stationary and marine requirements all over the world.

NORDBERG MFG. CO., Milwaukee, Wisconsin



Important features of NORDBERG RADIAL ENGINES

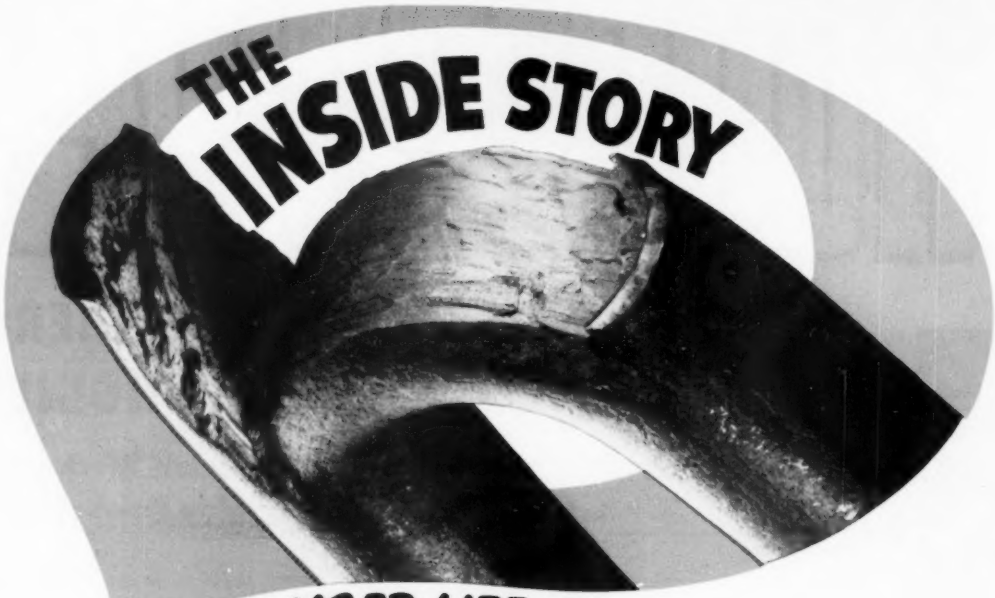
- ☆ LOWER INVESTMENT COST
- ☆ LOWER INSTALLATION COST
- ☆ LOWER OPERATING COST
- ☆ LOWER MAINTENANCE COST
- ☆ LESS SPACE REQUIRED
- ☆ AVAILABLE THREE WAYS . . . as oil burning Diesels, as spark-fired gas engines, or as Duafuel engines

Applicable for industrial and municipal power plants and central stations . . . wherever compact, economical, dependable power is required. For full details covering Nordberg Radials, send for Bulletin.

P652

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

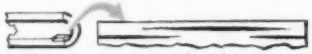


OF THE LONGER LIFE OF BYERS WROUGHT IRON

Every engineer will recognize this picture as a notch-fracture test specimen . . . and will appreciate the unusual physical properties suggested by the break.

The hickory-like fracture results from the unique structure of wrought iron. Tiny threads of glass-like silicate slag, 200,000 to 250,000 per square inch of section, are distributed through a matrix of high-purity iron. This fibrous structure, which might be compared to that of a stranded wire cable, equips wrought iron to withstand sudden shock, and to resist fatigue induced by continuing vibration.

Of even more importance in the average application is the *corrosion resistance* of wrought iron . . . which also comes directly from the unique structure and composition of the material. If a small section of wrought iron were placed under a microscope, a few of the multitude of silicate slag fibers would show up as in this sketch.



If corrosion attacks this specimen, it would first cover the entire surface . . . then concentrate at one point, and work inward. Soon it would encounter one of the slag fibers . . . and since this fiber is unaffected by corrosion, the inward march would be halted. This action is shown by this sketch.

Corrosion is now "detoured." It works right and left, until it comes to the end of the fiber, when it may start to work inward again. The process is repeated when the second line of defense is encountered. Pitting, and rapid penetration of the metal, is discouraged. Useful life is determined by how long it takes for corrosion to reduce the entire body of metal to its safe limit of thickness, rather than by how long it takes corrosion to perforate the wall at a few vulnerable points. The fibers also anchor the initial protective scale, which shields the underlying metal.

Every cost sheet today confirms the fact that the most expensive material you can use is that which must be replaced too soon—and too often. The extra service of wrought iron is helping tens of thousands of users to cut maintenance costs. We will welcome an opportunity to review your piping problem with you—and to recommend the places where wrought iron—on the basis of its past performance—can be profitably used. Ask for our booklet, "THE A B C'S OF WROUGHT IRON."

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

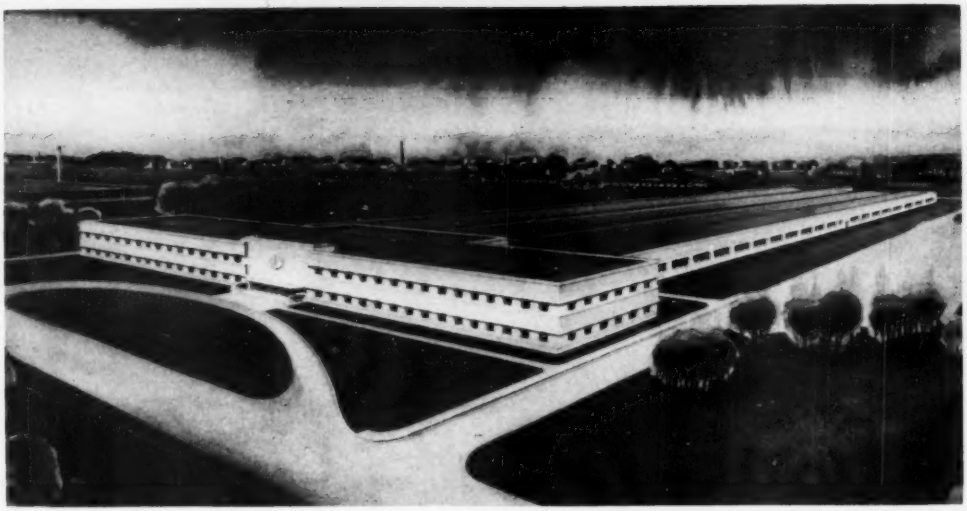
TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

CONTROL PANEL master-minds industrial plant's comfort air conditioning. It's but one example of how...

Modern Design Produces a Dream Plant

Powers Regulator Co new plant is one where the shoemaker's children aren't the poorest shod. Precise control of comfort and manufacturing conditions by modern instruments gives an efficient place to work in, summer or winter. **Next page**



NEW T-SHAPED PLANT is 290 ft wide, 515 ft long. Floor area is 130,000 sq ft on 13-acre site. There is ample space for future plant expansion and for parking. Design is conservative modern with pleasing lines, free of frills and unnecessary trim

Careful planning provides excellent facilities for the comfort, health

► CONSERVATIVE MODERN DESIGN, coupled with careful engineering, gives excellent facilities for both office and production personnel. A T-shaped building, 290 ft wide, 515 ft long, houses this new plant of Powers Regulator Co at Skokie, Ill. Several engineering features are noteworthy.

Heating, Air Conditioning. This system features a Powers modern control panel. In its design are integrated various types of pneumatic controlling, indicating and recording instruments. These master-mind the operation of the air-conditioning and heating systems.

Control panel and its equipment also serve as a working model of the company's products for this service. Glazed tile walls from floor to ceiling and asphalt tile floors in pleasing colors make the room attractive and easy to clean.

Thermostat in each office or room maintains desired temperature. Diffusers distribute conditioned air to each room. Convectors for heating have a pneumatically operated control valve on inlet side and shutoff valves on inlet and outlet. Inner and outer window sash and venetian blinds reduce heat transfer.

Forced hot water heats entire plant. Outdoor master controller operates an indoor submaster regulator, which controls hot water in heating system in direct relation to outdoor temperature.

Load Division. For greater efficiency and flexibility to suit occupancy needs, the air-conditioning system is divided into four parts. Each has its own fan, heating and cooling coil, humidifier, face and bypass dampers, air filters, activated carbon filters for odor removal, maximum and minimum fresh-air dampers, return-air exhaust dampers, static-pressure dampers, separate refrigeration compressor and evaporative condenser. Each system is further subdivided into three or more zones with a booster heater in each zone for summer operation when some zones need heat and others don't.

A special feature of each system is summer-reheat to permit moisture removal, but avoid overcooling on humid days.

Heating, Ventilating. This system is designed to provide maximum employe comfort in summer and winter. Wall thermostat pneumatically controls radiators and ceiling unit heaters. Two-temperature day-night control system is used.

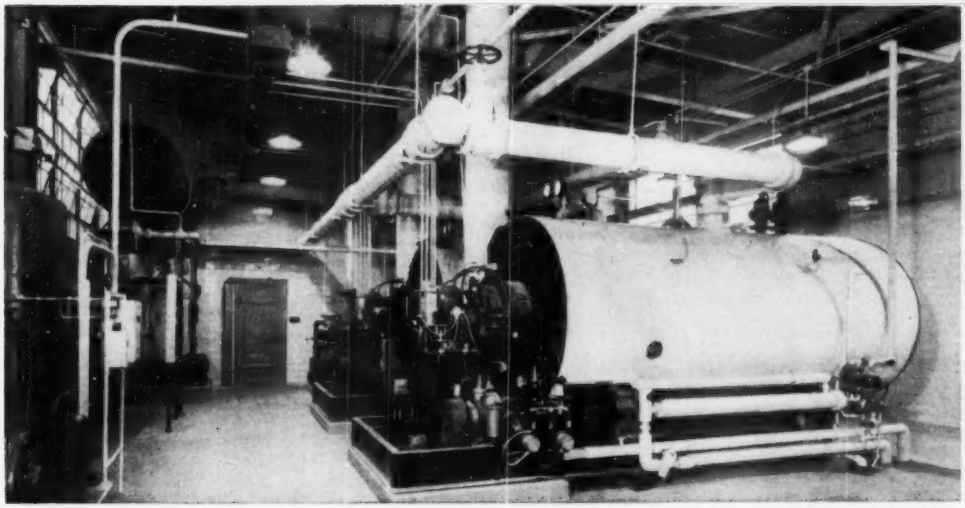
Room air is changed ten times per hour in summer, twice per hour in winter. Large ventilating fans keep room air under pressure so warm air leaks out in winter instead of letting cold air into the building.

Factory roof has 30 large motor-driven ventilators to give generous air circulation. All these, the well-insulated poured-gypsum roof, "Coolite" window glass and fluorescent lights, combine to keep factory temperature lower than outdoors in summer. Exhaust fans are used throughout plant to remove fumes and odors.

Boiler Room. Three boilers supply plant steam and hot water. Two oil-fired units handle hot-water load. Gas- or oil-fired unit operating at 200 psi is rated 2800 lb per hr and carries steam load. Underground oil tanks store enough oil for the three coldest months of the year, can be filled from tank cars or oil-tank trailers. Two centrifugal pumps circulate hot water. Instrument panel has a Powers Mastrol system of forced hot-water control.

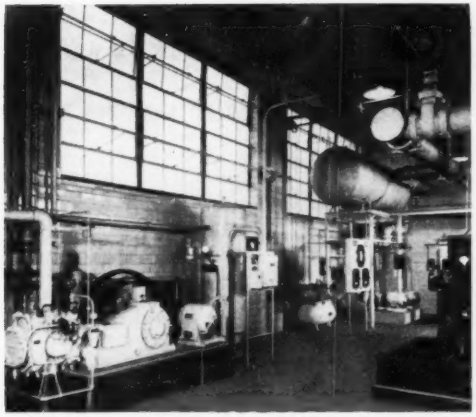
Electric Power. Two bus-duct systems give flexible and efficient distribution of 220-v 3-ph power throughout plant. Conduit wiring is held to a minimum, duct appearance is good and future expansion will be simple.

Four-wire lighting systems supply pendant-type fluorescent fixtures in work sections. Boiler and storage rooms have incandsecent lighting. Circuit breakers

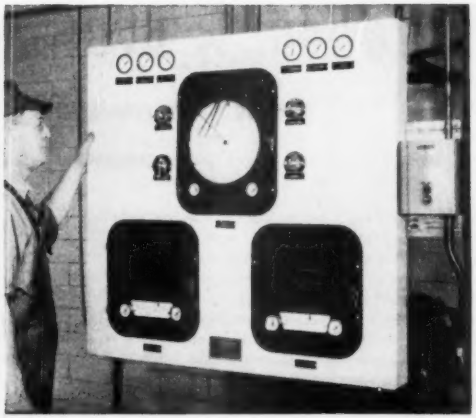


BOILER ROOM is at bottom of T in one-story end of the plant. Two oil-fired packaged boilers supply hot water for heating, process and domestic needs. Gas- or oil-fired unit generates process steam. Auxiliary equipment on left of firing aisle

and efficiency of office and manufacturing personnel the year round



COMPRESSOR supplies air for manufacturing departments. Other compressors supply air for control instruments in plant



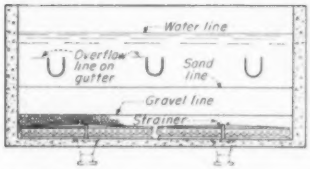
CONTROL PANEL for forced hot-water heating system. Hot-water temperature is varied in relation to outdoor temperature

are used throughout plant in light distribution panels instead of fused switches.

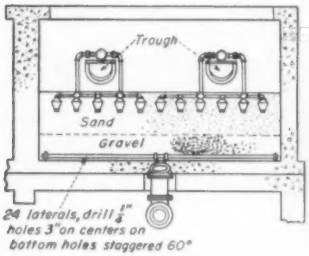
Fire Protection. Entire plant is equipped with completely automatic sprinklers. Office heads are flush type, factory pendant. Truck docks and garage have dry-type systems. Large fire doors operate on electro-pneumatic power.

Building. Attractive colors and furnishings are used throughout. Acoustical ceilings, flush-mounted power services, generously sized rooms and corridors, an attractive cafeteria, and well-equipped employe spaces are a few of the features of this plant. Stone-ledge overhang strip above building windows helps reduce cooling load in summer.

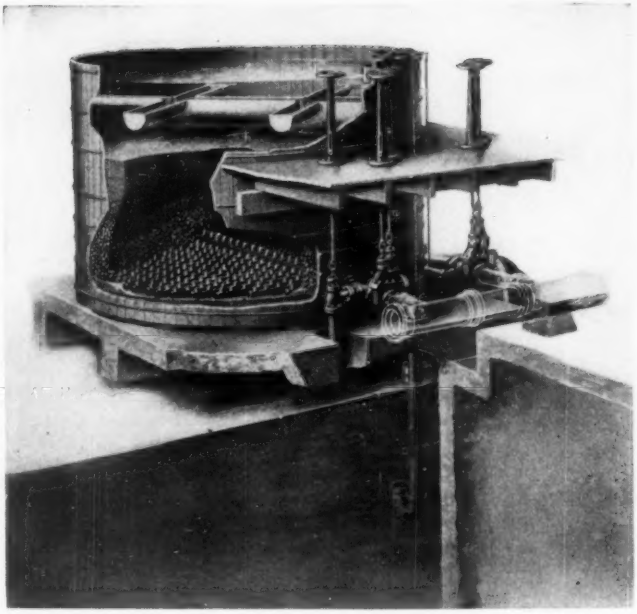
A trip through this building shows the excellent results of careful planning and judicious use of modern design. It is truly just what the doctor ordered.



SAND FILTER, simple, rapid, has three main layers—sand, gravel, underdrain



SPECIAL FILTER assembly features use of filter screens across water inflow



PRESSURE FILTERS, essentially same as rapid sand designs, *left*, let water enter under pressure. This is an advantage because filter can connect into feed piping

Filtration: A Growing Industry Aid...

Because greater pumping from ground-water sources means higher suspended solids

By **SHEPPARD T POWELL,** *Chemical Engineer*

► IN ITS SIMPLEST FORM, filtration is the removal of suspended solids from a passing water—primarily a mechanical job. The way you do it depends on how fine and complete a removal you want.

For instance, you can choose your filter from several materials, table on left, p 77. These materials act like a sieve. Any suspended particles in a passing water stream, too large to fit through the strainer holes, stay behind. But you'll never get complete clarification with such a crude setup. Let's take sand, an excellent filter material.

At the start, with a clean bed, the solids drop out at a rate determined by (1) size and gradation of sand (2) speed of water flow through bed (3) thoroughness of pretreatment. This pretreatment, applied to the water itself, includes settling basins, additions of coagulating chemicals, etc. As time goes on, a properly operating filter increases in efficiency. Solids tend to penetrate less and less.

Here's what happens. Flocculated matter clogs up voids in the bed. In some sand filters, a gelatinous film forms around the grains by biological action. It is much more pronounced in slow filters, to the point where a slimy, difficult-to-break coating is seen. This coating, a *Schmutzdecke*, is highly valuable for effective clarification even though it exacts a price in loss of head.

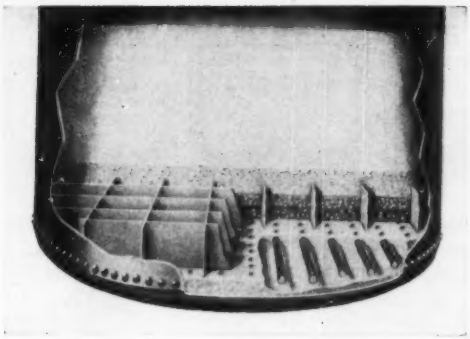
You can build an artificial Schmutzdecke with a chemically formed floc. But unless you use silicious jellies or similar sticky materials, the artificial coating is never as strong as the biological one.

One of the worst things in filter operation is a *breakthrough*. As the name suggests, the filter medium fails to hold back the desired amount of suspended solids and the effluent is polluted.

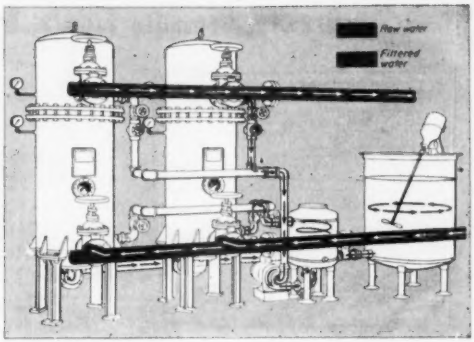
Pressure-operated filters experience this trouble much oftener than gravity designs. Solid penetration, under pressure, is deeper to begin with (see Surface Deposits, top p 76). If filtering runs for long periods without backwashing, back pressure or loss of head increases. In overcoming it the protective coating or even the individual sand grains are dislodged and suspended solids break through.

Operation varies not only with design but with time of year, particularly in treating surface supplies since coagulated matter passes more rapidly in winter. Entrained gases and other factors also change with temperature rise.

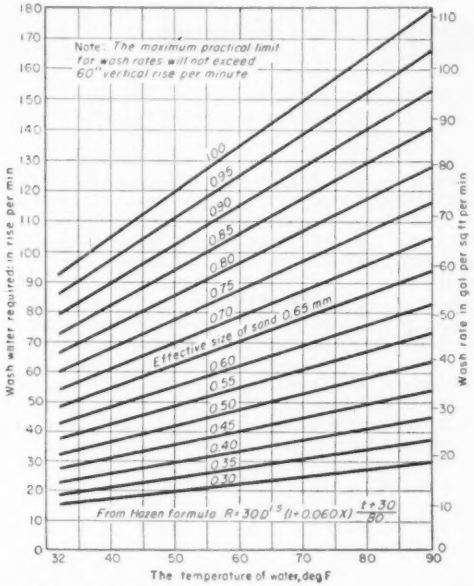
Gravity Filters. Let's look at different types. The simplest, slow sand filters—sometimes called English or just sand filters—consist of beds of fine sand, 18 to 48 in. deep, resting on some form of underdraining. Filtration rates run low,



SECTIONALIZED underdrain system gives proper distribution; yet prevents shifting of underdrain gravel, always a problem



PRECOAT of diatomaceous earth on porous tubes or plates enables these surfaces alone to filter the incoming raw water



BACKWASH RATES that are desirable for an allowable 50% expansion of different-sized sands can be picked off this chart

2 to 5 gal per hr per sq ft of filter area, too low for boiler feedwater service.

Rapid-sand filters, left, p 74, housed in wood, steel or concrete shells, have three principal layers. At the bottom is an underdraining or collecting system, then a bed of graded stone or gravel, and lastly 24-36 in. of filter medium. The table, p 77, shows a good layer depth. Special control valves for regulating flow rate, loss-of-head gages, backwashing apparatus and wash water troughs or gutters complete assembly.

Normally, water flows down through the sand and gravel, through a strainer to the underdraining, and into a clearwell or filtered water basin. To clean filter, reverse flow and force water back up through bed. Collected solids wash off the sand, are carried to the discharge water troughs. From here they are led to the sewer. In some units, steam agitates the sand. But in many recent designs a high-velocity wash water serves as the only agitating means.

Pressure filters are essentially the same as rapid sand designs except you put them in a closed steel tank and send water through under pressure. This is desirable in feed treatment since you can connect the filter right into the water system. So you'll find this class in power plants.

Coke filters often serve as an adjunct to sand filters, or alone where a quantity of iron or manganese needs removal. But their main purpose is usually for aeration and as pretreatment for other purification methods.

Coagulating and settling basins have become increasingly important as a design feature for a rapid sand system. They serve to: (1) decrease filter load by amount of large suspended solids that drop out in the settling basin (2) furnish some carryover coagulated matter that helps build up a Schmutzdecke in the filter itself.

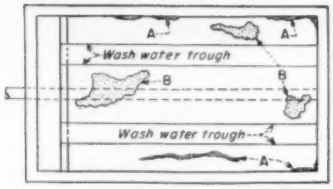
Underdrains. For years the underdrain or collecting system has been made up of a center manifold with laterals tapped in at right angles and spaced evenly over the filter floor, diagram top of p 74. Strains, termed strainer heads, cups or sand valves, screw into these laterals.

Many engineers use only perforated pipes for strainers. These pipes are capped at the free end and tapped on the underside with 7/32-in. holes, staggered at 45 deg and spaced 3 in. apart. You vary the spacings and size of tapped holes to suit special needs. But if you do decide on underdraining, study its possible effects on size, depth and grading of your gravel bed.

Still another approach to underdrains is the use of false bottoms. They can be perforated metal plates, wooden grids or lattice, slotted, reinforced concrete slabs or subway grating, supported from bottom of filter chamber.

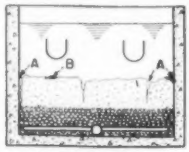
It is not generally necessary to supply a large underdrain chamber. A free, unobstructed passage for water flow un-

Gravity, Pressure Filters, Softeners Share These Headaches



Plan

A–*Cracks in filter bed* B–*Surface deposit accumulations*



Cross Section

SURFACE deposits on filter medium add special problems of their own, see below

A–*Fine filter medium* B–*Graded gravel or anthrafilt* C–*Underdrainage system*

LOCAL OBSTRUCTIONS and channeling upset normal filter operation. They can also cause severe loss of filter medium. But following the proper steps avoids trouble

AIR AND GAS formations can set off a chain of difficulties in pressure filters just as they do in softeners. But through understanding, they can all be prevented

SURFACE DEPOSITS, *above,* build up on filter medium and, if left unattended, form mud balls or sticky sludge masses that (1) reduce active area of filter bed (2) foul up underdrainage system (3) produce unbalance in backwash (4) give off turbid water effluent. To correct, you may have to reduce freeboard by adding more filter medium, or lower backwash takeoff. Other steps: proper pre-treatment, settling of influent water; inspection of filter beds; developing, maintaining backwash.

LOCAL OBSTRUCTIONS, *top right* can create disastrous hills and valleys, *see 2 above,* in filter beds, upsetting even distribution of fine and coarse layers so backwash velocities run high in fine layers and, in extreme cases, carry off fine sand or anthrafilt. Best preventives: constant backwash pressure, coupled with gradual admission of backwash water to avoid shocks. Follow with regular penetration tests with probe to see if layers are same depth you laid down.

AIR AND GAS formations, *bottom, right,* display progressively more upsetting effect, *see 4, 5, 6, above.* First they form barrier that cuts down on operating rate. As they bubble to surface they begin to shake and sift filter medium (or water softener, for that matter) until they establish definite channels and holes for short-circuiting incoming water. First indication is bubbles. Cure: proper backwashing, control of algae in water.

FILTRATION *continued*

der the false bottoms is enough. It is usually desirable to limit head loss to one-half inch or less in normal service.

Photo, top left, p 75, shows an underdrain system with sectioning to insure proper water distribution and prevent shifting underdrain gravel. This setup neatly solves the problem of shifting supports in horizontal pressure filter or zeolite units.

Remember, the gravel bed in a filter should remain stationary. So be sure not only that the underdrain supports won't shift but also that the gravel layers will stay put. Bottom layers ought to be laid by hand and each succeeding layer leveled off. Use only clear, hard material, with selected round gravel preferred over other aggregate. Deeper gravel beds give better wash distribution up to a point. You gain little if anything by going above 18-20 in.

Some filters eliminate gravel. They use false bottoms of perforated metal sheets with a fine brass screen between. But their use is definitely limited.

How about substitutes for underdrain systems? They've been tried. Porous plates, like carborundum or other materials, give uniform filtering and backwashing as long as they stay clean. But when they clog up, you have to clean the plates thoroughly, usually with acid. Some designs can be cleaned in place; others require dismantling. Chief advantage is a saving of gravel or other supporting medium and a shallower over-all filter assembly.

Filter Mediums. Sand is first choice for cold-water filtering. For feed treatment, pure quartz sand, free from loam, clay or acid-soluble material, is preferred. Its exact size varies with kind and temperature of water under treatment, filtering rate, bed depth, other factors. For average conditions, from 0.40 to 0.45 mm proves effective. Some have employed sands of 0.60 mm or larger.

Filter materials are classified on the basis of 10% size. Such a basis is highly significant since the 10% finer sands have materially greater effect than the effective size on frictional resistance and flow characteristics within a filter bed. Further, this 10% is also of greater value in removing suspended solids,

FILTER-LAYER DEPTH AND SIZING[1]

SAND AND GRAVEL

Depth, in.	Material	Effective sizing
27	Fine sand	1.45 to 0.50 mm
3	Coarse sand	0.8 to 1.2 mm
3	Gravel	¼ to ½ in.
4	Gravel	⅜ to ¼ in.
5	Gravel	1½ to ⅜ in.
6	Gravel	2½ to 1½ in.

ANTHRAFILT AND GRAVEL[2]

30	No. 1 Anthrafilt	0.68 to 0.72 mm
3	Gravel	¼ to ½ in.
4	Gravel	⅜ to ¼ in.
5	Gravel	1½ to ⅜ in.
6	Gravel	2½ to 1½ in.

ANTHRAFILT

30	No. 1	1.68 to 0.72 mm
2	No. 2	3/16 to 3/32 in.
3	No. 3	5/16 to 3/16 in.
3	No. 4	9/16 to 5/16 in.
4	No. 6	1⅜ to 13/16 in.
6	No. 7	2⅜ to 2 in.

[1]Nordell, Eskel, *Water Treatment for Industrial and Other Uses.* Reinhold Pub Corp, 1951, p 309.

[2]Graded anthracite coal.

STRENGTHS AND WEAKNESSES OF PRESSURE FILTERS

ADVANTAGES

May be interposed in the water mains under pressure, thereby eliminating low-lift pumping.

Require less space than gravity filters of the same capacity.

Can be constructed rapidly.

May be operated at a high loss of head.

Additional units may be added without materially affecting the general design of installation.

When used to purify water from deepwells, chance for outside bacterial contamination is less.

When equipped with multiport valves, operation is simpler than required for gravity units.

DISADVANTAGES

Filter sand is not easily inspected, and efficiency of the backwashing of sand cannot be observed.

Application of coagulant is usually not as well controlled as in gravity units.

There is danger of passing undecomposed alum or other chemicals that are used through the filters, because of the short period of reaction possible between the point of chemical application and the passage of water through the filter bed.

Passage of sand into filtered-water system is possible when underdraining system fails, since no clear-water storage basin is provided in most installations.

It is more difficult to maintain constant rates of filtration with pressure filters than with gravity filters.

largely because these fine grains wind up on the bed surface under the selective grading of grain sizes during a backwash.

Anthracite coal is a desirable medium, particularly with hot lime-soda softening systems and where iron and manganese run heavy. Its chief merits are its lower density, little more than half that of sand, and its irregular shape. These properties produce a porous bed that does not pack when backwashed.

Area of angular grains is greater per unit volume than that of the more spherical sand grains. This aids in trapping floc and permits a larger grain size without loss of filtering efficiency. Further, with a coarse-grain size deeper parts of bed become effective, and you can use higher filtration rates with longer runs before head loss buildup becomes troublesome.

Some applications are made of anthracite's chemical inertness. Chief is that only about 5% dissolves in the presence of strongly alkaline waters, whereas such waters, especially hot, leach silica from sand until it is dissolved completely. In boiler feed this property is important because of silica difficulties.

With anthracite, it is good practice to employ a 30-in. bed of relatively coarse anthracite, 0.60-0.70 mm, and with enough *freeboard* height to permit 50-100% expansion during backwashing. (Distance between medium's surface and lip of wash trough is called the freeboard.)

If you change over an existing filter to anthracite you may find its shell is not deep enough to allow the required backwash expansion. To get around this, use magnetite in place of gravel as a support. Porous underdrains are also used.

One designer reasoned that in properly coagulated water about 90% solids do not penetrate more than 2-3 in. below a sand-filter surface. So he built filter screens on 15-in. centers a short distance below the surface. With the upper portion carrying normal load, he introduced equal flow rate at the new screen level. This makes lower part of bed, however, carry 50-100% extra load.

Precoat Filters. Recently a number of manufacturers have designed filters that pass water through porous tubes or plates instead of sand or anthracite, diagram, top, right p 75. Some designs precoat these tubes with diatomaceous earth, diatomite or other form of filter aid to help get desired clarification.

Water enters the shell, passes through the cylinders and goes to outlet chamber. This one, in diagram just referred to, differs from some on the market. Backwashing of individual tubes takes place automatically with a mixture of clarified water and air. Air propels the water from inside to outside of tube, displacing accumulated deposits.

Where precoating is used, incoming raw water is fed a slurry of diatomaceous earth, which settles on outside of individual tubes as water passes through. This deposit gives greater filtering action to later water. To remove this coating or filter cake, build up pressure on both sides of tubes by closing the effluent valve and then the inlet water valve.

If you suddenly release pressure on outer side of tubes by opening the backwash water valve, a rush of water from inside displaces the filter cakes. The displaced matter falls to bottom of a conical shell and from there can be discharged to waste.

Backwashing. Best way to establish optimum backwashing is to observe backwash water leaving the filters. Then set the rate at the point just below where fines start to carry over.

Backwashing is carried out by one of two ways: (1) high-velocity wash—passing filtered water upward through filter at about 12-30 gal per min. per sq ft of area without other agitation or (2) low-velocity wash—passing same water at about 7.5 to 15 gal per min per sq ft with agitation by mechanical valves or water jets, compressed air or steam. Just which you use depends on filter construction. To switch from one to the other requires drastic changes.

Curves, p 75, show a method of computing desirable wash rates for a 50% expansion of different sand sizes at different temperatures. In any event open wash-water valves slowly to avoid upheaval of supporting gravel and give even distribution of water. This is especially important if air becomes entrained within the gravel or the underdrain system itself.

Wash-water troughs, gutters or similar equipment serve two purposes:

(*Continued on page* 204)

Furnace Design Of Large Steam Generators

Giant furnaces need delicate control of temperature, heat distribution. Second of two articles tells how it is done

By MAX H KUHNER
Vice-President of Engineering
Riley Stoker Corp

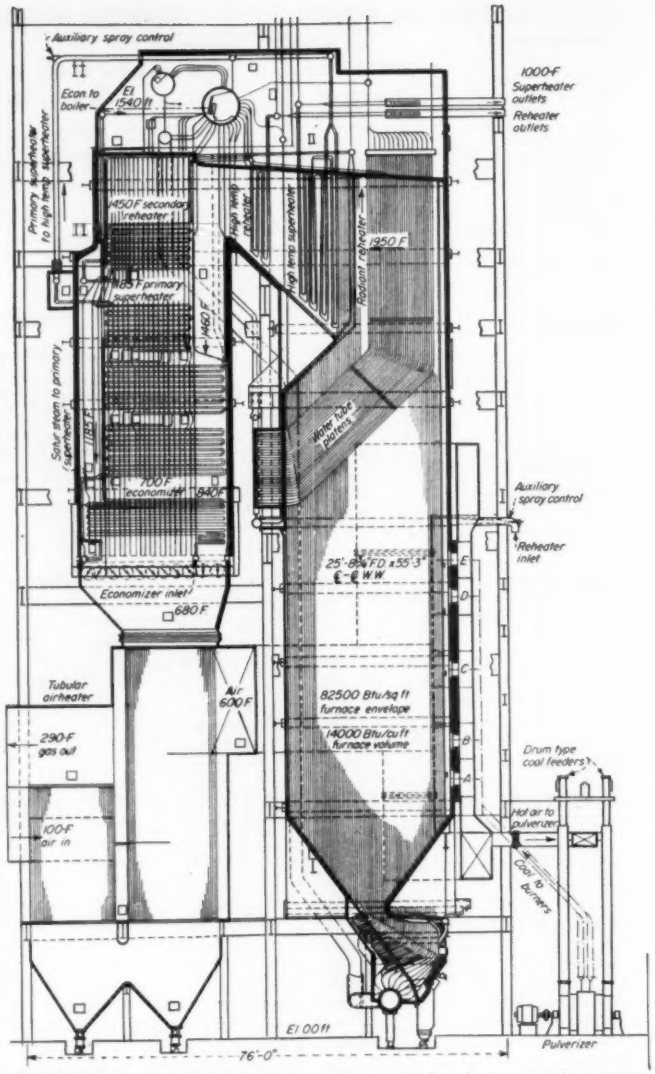
► LAST MONTH we looked at the influence of fuel type and grade on furnace design. We also saw the effect of furnace design on superheater and reheater location. This article will further discuss design for furnace temperature distribution, furnace condition and steam temperature, and furnace ash removal, with a quick look at the future.

Temperature Distribution. Uniform temperature distribution from side to side is desirable for any boiler, but high-temperature superheaters and reheaters in large units give this factor serious importance. Outer skin temperature of high-pressure alloy-steel superheater tubes carrying 1000-F steam is 1050 F or above under best of conditions. If temperature on superheater elements varies widely across furnace width, heat input to superheater tubes varies correspondingly. Heat differential across superheater system may rise to 100 F or more.

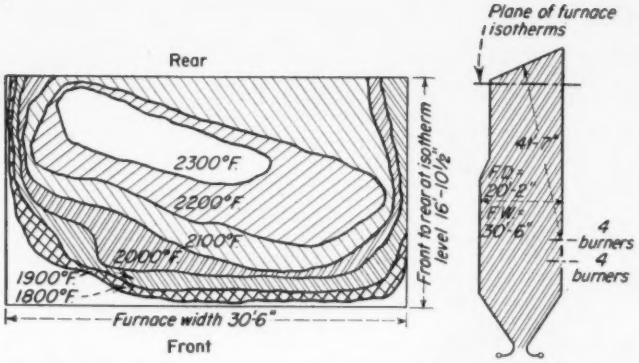
Higher-temperature steam has a greater specific volume. Since inlet and outlet pressure differential is the same for all superheater elements, less weight of steam flows through higher-temperature tubes. This raises steam temperature and aggravates tube overheating. Result may be tube failure.

Fig. 2 shows isotherms recorded in furnace of 450,000-lb-per-hr pulverized Western-coal fired boiler delivering 432,000 lb per hr with all eight burners operating. High-velocity shielded thermocouples were used. Although temperature pattern across furnace is not ideal, it is acceptable for a 900-F unit.

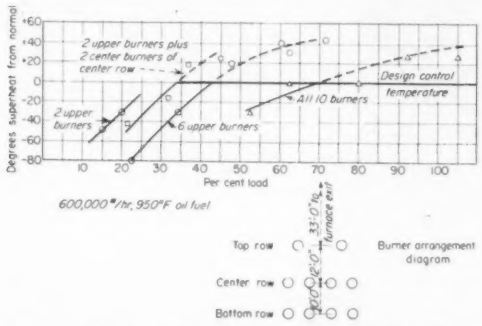
Furnace temperature and temperature of furnace-exit combustion products are a function of furnace-envelope cooling effect. The wider the furnace, the lower the effect of side-wall cooling. For wide units it is possible to divide the furnace into two, three or more compartments by using watercooled division walls, thus creating two, three or more individual furnaces. This, however, requires careful heat-release adjustment in each furnace so heat delivered to each superheater and reheater section above is exactly the same. Unbalance of burn-



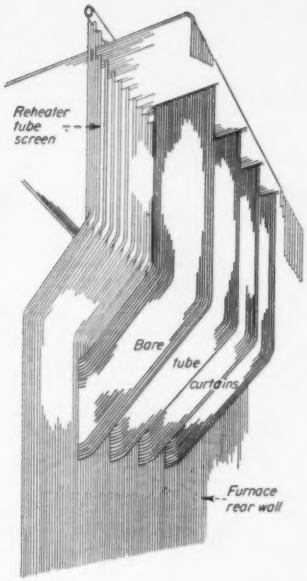
1 FURNACE area divided into five compartments by four bare watertube curtains above burner level. Divided furnace requires close heat-distribution control



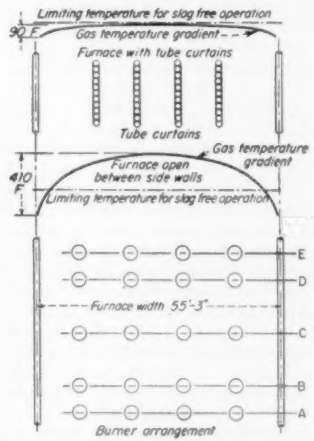
2 **ISOTHERMS** recorded at top of furnace of 450,000-lb unit, using high-velocity shielded thermocouples. Pattern not ideal, but is passable for 900-F operation



3 **USING BURNER** groups changes heat-level gravity center to hold desired steam temperature in 35-100% load range



4 **CURTAINS** of bare tubes in tangent contact split furnace into segments



5 **EFFECT** of curtains on furnace-exit gradients vs gradient in open furnace

ing rate in furnace compartments may not only cause slagging, but also overheating of superheater and reheater.

To prevent this difficulty, tube platens were devised, Fig. 4. They consist of bare watertubes in tangent contact to form solid curtains spaced across the upper part of the furnace. Furnace area at and below burner levels remains open between side walls. Number and size of curtains is determined by furnace cooling required for predetermined furnace-exit temperature. The four curtains used in the design, Fig. 1, are equal in total area to two complete furnace side walls, or one center wall.

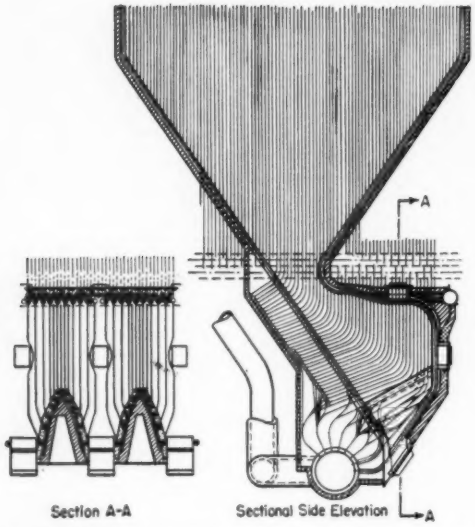
Effect of tube curtains on temperature gradient across furnace exit is shown by Fig. 5, compared with expected gradient of entirely open furnace.

Furnace Conditions. Close and accurate control over steam temperature is vitally important for high-temperature installations since changes in furnace conditions tend to change superheater and reheater performance. Clean furnace walls result in lower furnace and steam temperatures. Ash and slag coatings on certain furnace-envelope areas produce higher furnace and steam temperatures. A practical steam-temperature control must, therefore, have enough range to compensate for all furnace-wall conditions expected during normal operation. In certain isolated cases steam-temperature level is controlled by intentional control of furnace-wall cleanliness. Manual and mechanical deslagging devices are used in these cases.

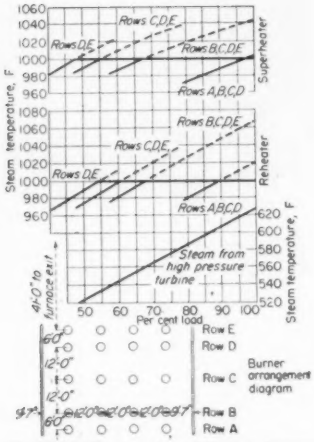
Fig. 3 graphically records the effect of furnace heat level on superheater performance of a 600,000-lb-per-hr boiler. Ten flare-type burners are installed in three horizontal rows. Bottom and intermediate rows have four burners each, the top row has two. Using groups of burners permits raising or lowering heat-level center of gravity within furnace to maintain required steam temperatures from 35 to 100% of capacity.

Using only top-level burners for lowest loads and adding or subtracting burner rows for higher or lower loads gives effective maintenance of desired high steam temperature over wide load range. Electric ignitors and remote pushbutton operation of fuel and air supply in individual burner rows make the method safe and convenient.

With furnace heat level established, required steam temperature is held by automatically-controlled flow of combus-



6 **INTEGRAL** ash hopper hung on furnace structure, floats with it when furnace expands, needs no elaborate sealing



7 **RESULTS** of using different burner groups to suit furnace cleanliness

tion gas over convection surfaces of superheater and reheater, by direct-contact water spray, or both.

Fig. 1 is a design study of a modern central-station boiler proposed for a 200,000-kw reheat turbine, 1800 psig, 1000-1000 F. Twenty horizontal flare-type burners are set in front wall in five rows of four each. One pulverizer feeds each row. Combustion-air system branches through individual ducts and control or shutoff dampers for each group of four burners.

Full-capacity boiler output needs only 16 burners and four pulverizers, thus allowing adjustment necessary in furnace heat level for changes in furnace-wall cleanliness. Burner levels B, C, D and E are used with a clean furnace. Levels A, B, C and D are used while furnace envelope is ash coated. In both cases boiler will deliver its full capacity.

Expected superheater and reheater performance using primary burner-level control is shown by Fig. 7.

Provisions for auxiliary feedwater-spray controls for both high-pressure and reheat steam are expected to be used only in emergencies, during abnormal furnace conditions, and for possible washing of turbine. Controlled combustion-gas flow over superheater and reheater surfaces provides automatic steam-temperature adjustment.

Radiant reheater surface is placed over upper area of furnace rear wall. Tube screen between furnace and high-temperature superheater is formed by reheater tubes on wide centers. Part of high-temperature superheater can see furnace radiation through spaces between tubes of radiant reheater.

Furnace Ash Removal. Most large steam-generating units are suspended from overhead steel structures. Vertical expansion of boiler in Fig. 1 causes low point of furnace to move 6 in. below its cold position. If separate ash hoppers supported from foundation are used, elabroate flexible sealing joints are needed to pevent uncontrolled air entry to furnace and gas and dust leakage from furnace. Air leakage lowers efficiency; gas and dust spoil housekeeping.

Furnace-bottom ash hopper is preferably integral with the furnace—supported from furnace structure and floating with it. No flexible seals are required. Dry ash discharges by gravity into watercooled pocket where it is further cooled before being intermittently tapped through external ash-transport system. Detail of this integral ash hopper is shown in Fig. 6. No water is used for quenching ash, and heat loss from this source is avoided.

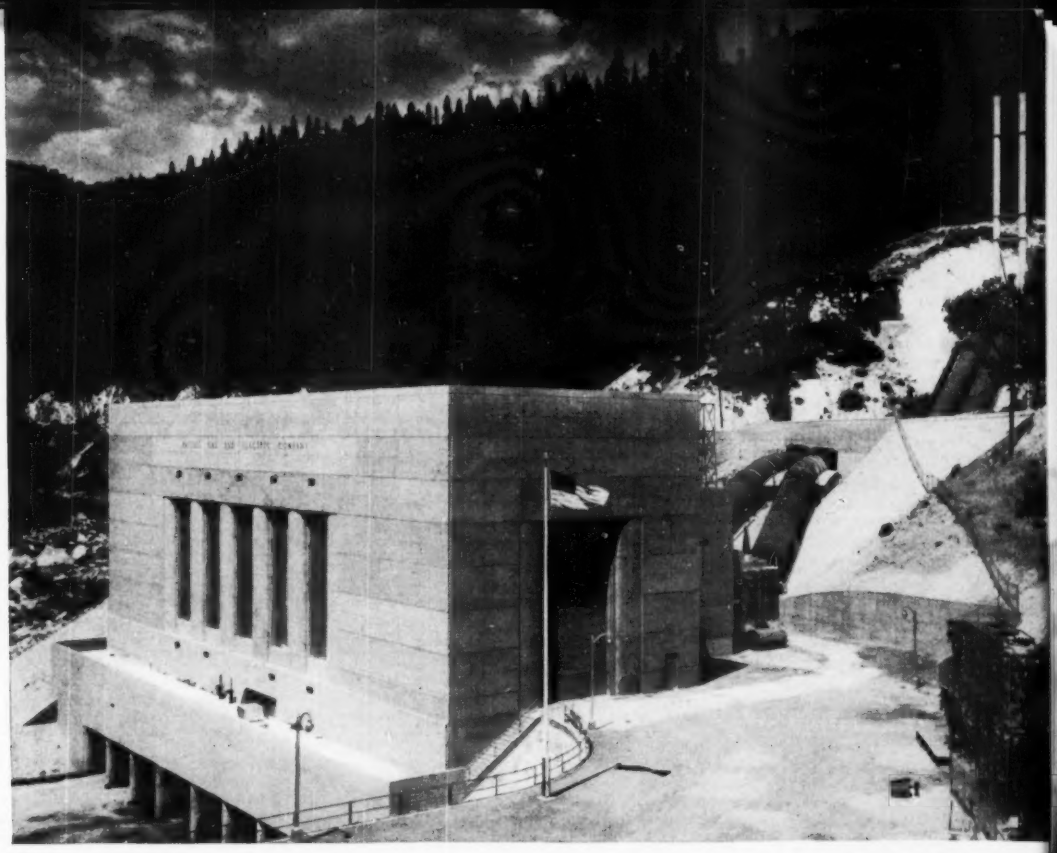
The Future? The question is often asked— What's the ultimate size to which steam-generating units can be built? Can boiler capacities keep step with projected turbine size? Or will it become necessary to revert to two or three boilers per super-sized turbine?

Manufacturing facilities of boiler industry are such that one-boiler per-turbine units are possible and practical for largest size so far proposed. A single boiler unit of 3,000,000-lb capacity is possible. And it should be just as reliable and present no greater problem in operation than an equal pressure-temperature unit of 500,000 lb. Suspension and expansion of such a unit appears a purely mechanical problem.

Furnace design will need greater care because a 3,000,000-lb boiler will be over 100 ft wide. Heat distribution and furnace-exit gas temperature will have to be under close control.

Immediate future trend shows need for higher steam temperatures with greater unit size rather than steam pressures above safe limit for natural-circulation boilers. Further metallurgical developments will realize steam temperatures of 1200-1300 F at a price within reach of boiler and turbine purchasers. Accelerated rate of steam dissociation may become the ultimate limit of power-plant steam temperatures.

Gains to date can be attributed largely to close cooperation between operator and designer. Many new things appear practical in the immediate future, yet the final test of any boiler design is its operational characteristics and ease of maintenance. To turn new developments into workable reality will call for even closer teamwork and exchange of information and ideas.



RATED AT 93,000 HP Cresta Power House takes its water from forebay through tunnel and penstocks totaling 21,600 ft. 220-kv bus and oil circuit breakers for plant stand in yard, *right*, built up by tunnel dump and rock facing in river bend

Cresta Hydro Plant—Link for Completely Developed River

By **ELMER F MARYATT,** *Division of Hydroelectric & Transmission Engrg Pacific Gas and Electric Company*

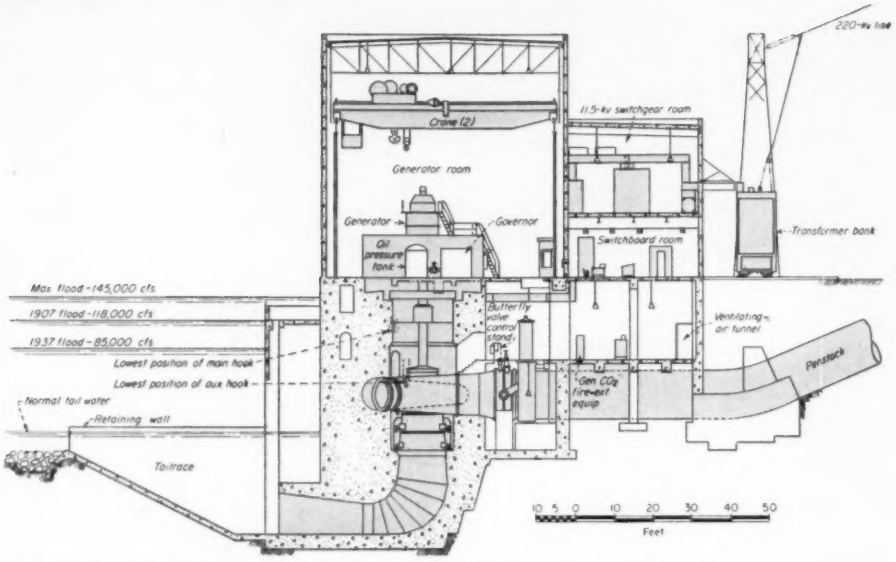
Complete harnessing of a river for electric power production requires series of hydro plants along its length to take advantage of every change in water elevation. Here's new plant that forms one such unit in a chain in the Sierra Nevadas

► CRESTA POWER HOUSE is on the North Fork of the Feather River in California, just below Rock Creek Power House, see POWER, May 1952, pp 79-82. The Rock Creek afterbay is the Cresta forebay. It has 4300 acre-ft capacity.

Diversion dam is a concrete overflow gravity type similar to that of Rock Creek, except it has a crest of 350 ft and height of 113 ft. The gate equipment is identical to that of Rock Creek. Since Cresta intake is on opposite side of the river from Rock Creek, the dam arrangement is opposite hand. Emergency supervisory control of the gates is in Rock Creek Power House. Water-level indication telemeters to the Cresta Power House.

Water tunnel is 20,800 ft long, most of which is a 26-ft horseshoe section unlined. About 2000 ft is concrete lined. The lower 500 ft is 18.5-ft diameter, concrete and steel lined. Steel lining resists internal pressure and prevents leakage near the lower end. A differential surge chamber connects about

CRESTA PLANT *continued*

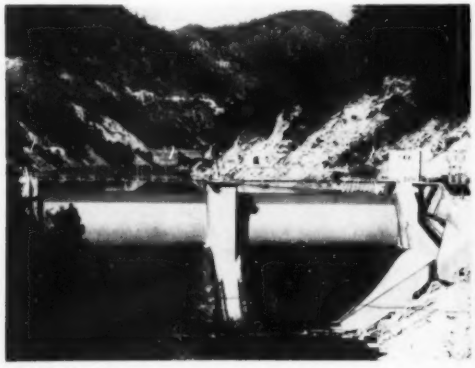


TWO TURBINE SHUTOFF BUTTERFLY valves, 144 in. diameter, operate hydraulically from penstock water pressure. Steel slide gates at draft tube outlet aid in dewatering for maintenance. Crane hook passes through hollow main shaft

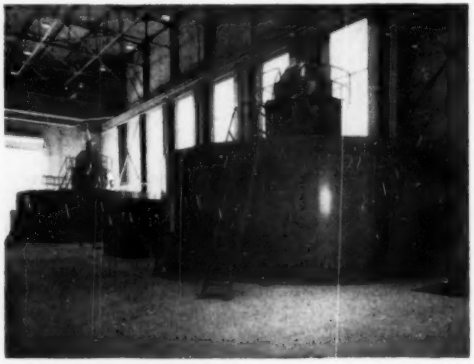
900 ft above the lower end of the tunnel. It is 46 ft in diameter by 125 ft high with a 16-ft-diameter by 125-ft-high riser pipe. Top of the surge chamber opens to atmosphere.

Two welded steel penstocks, averaging 790 ft long, 12 ft diameter, each have one 156-in.-dia hydraulically operated butterfly valve at the upper end. One 42-in.-dia valve is installed for tunnel sluicing. The 144-in.-dia turbine shutoff butterfly valves operate from penstock water pressure.

While Cresta stands immediately downstream from Rock Creek, it can carry 500 cfs more water because Bucks Creek Power House and other minor tributary streams discharge into the river above the Cresta intake. The francis turbines at Cresta are designed for 1750 cfs each at 254-ft effective head, 290-ft static. They are rated at 46,500 hp, 180 rpm. Each turbine has a 100% capacity pressure regulator with a through-type energy absorber. The pressure regulators are designed for servomotor stalling. Servomotor energy, however, is used for control purposes only. The pressure regulators are self powered from penstock pressure.



CRESTA DIVERSION DAM is 113 ft high with 350-ft crest. Drum gate emergency control is in the Rock Creek Power House



TWO 37,500-KVA GENERATORS produce 60-cycle ac at 11,500 v with speed of 180 rpm, use rheostatic-type voltage regulators

Draft tube and pressure regulator discharge tube have steel-plate linings. Each is fitted with steel slide gates at the river outlet, and dewatering equipment is provided.

Cabinet-type governors contain the actuator, relay valves, two pressure-oil pumps, one electric-motor driven and the other water-motor driven, automatically controlled, an air compressor and oil-sump tank. Oil-pressure tank mounts on the floor external to the cabinet at the rear. Governor systems for the units are entirely independent of each other.

Generators are each rated 37,500 kva, 0.9 pf, 11,500 v, 60 cycle. Class B insulation is used throughout. Calculated short-circuit ratio equals 1.7. The enclosed generators use internal surface coolers. Each has direct-mounted exciter. One motor-generator spare exciter set serves both machines. Batteries energize the exciter field.

Pumps take water from the tailrace for the generator surface coolers. A temperature-sensitive bulb in the air discharge from the generator controls water flow to the surface coolers through a regulating valve in the water-supply line. This (1) prevents excessive cooling of the generator during light loads (2) insures against high temperature due to plugging of a manual-controlled valve. Increased temperature calls for more water. Since this is the characteristic of the valve it is self-flushing. Operators tend to use excessive cooling water to avoid frequent manual adjustment. Generators excessively cooled have collected condensed moisture internally. Because of the 15-psig limit on surface coolers a throttling valve is needed in the water-supply line. To insure holding the last cooler section full of water it may be necessary to elevate some portion of the discharge pipe as high as the top of the coolers and provide an air vent.

The combined spring-supported thrust bearing and guide bearing are above the rotor. The rotor carries amortisseur windings. Rheostatic-type voltage regulators give complete control of the generator voltage without a field rheostat.

Crane Utility. Main shafts of the units are hollow-bored throughout their length. This allows passing down from the crane a steel cable for lifting and lowering the turbine runner for replacement or repairs. The runner must be removed more or less frequently to replace wearing rings. If the runner can't be removed from below, the entire generator and upper turbine cover must be dismantled. This takes about four times as long. In addition to this waste of time and money, the extra elapsed outage may mean water over the dam—representing lost power, never to be recovered. Our company adopted this feature in 1920 as standard practice.

Electrical Layout. The 11,500-v metal-clad bus has a main and auxiliary section. There are four air-blast circuit breakers, one for each generator, one for a bus tie, and one for the station-service power transformer. Each connects to the auxiliary bus through a gang-operated disconnecting switch and all are interlocked. The bus-tie breaker may be switched in place of each of the other breakers through the auxiliary bus, avoiding a complete duplicate breaker installation. The main transformer bank connects without a breaker to the main bus through disconnecting switches only. Generator and transformer leads are metal-clad from the terminals to the bus. Overlapping differential relay protection is used for the generators, 11,500-v bus and main transformers. A fault in the main transformers will take out the entire station by differential action. Dc emergency lights are provided, station power automatically cuts over to an outside source. Carrier-current relay protection and communication use the 220-kv lines.

Main transformer bank lines up parallel to the wall at the powerhouse rear. Low-voltage leads pass out through the wall at about the elevation of the transformer terminals. This reduces the lead length and makes metal-clad bus construction convenient.

The 220-kv bus and breakers are in the yard off to one end of the powerhouse. Nature was a little more generous in providing yard area here than at Rock Creek. Owing to a bend in the river a deposited area, augmented by tunnel dump and rock facing, provided a very usable yard.

Blowers force filtered air into the station for ventilation and maintain a positive pressure indoors. This keeps out dust and reduces cleaning effort. Part of the heat dissipated by generator surface coolers is recovered and added to makeup air to keep the chill from generator room and floors below. The same heat exchangers may be used for cooling during warm weather by passing water from the tailrace through them. Air for the switchboard room passes through an automatic air-conditioning unit, which supplies either warm or cool air. Electric heat in this unit also serves the office and shop area. Cooling is done by water circulating from the penstock.

SWITCHBOARD AND CONTROL ROOM are kept comfortable by an automatic air-conditioning unit and an electric heater

PRINCIPAL POWER-PLANT EQUIPMENT

Cresta Power House, Pacific Gas & Electric Co

Generators, 2 37,500 kva, 0.9 pf, 180 rpm, 11,500 v, 60 cycle	General Electric Co
Turbines, 2 46,500 hp, 254-ft head, impulse, 1750 cfs, 180 rpm	Pelton Water Wheel Co
Governors, 2 Oil-pressure cabinet type	Woodward Governor Co
Turbine butterfly valves, 2 144 in., hydraulically operated	Pelton Water Wheel Co
Pressure regulators, 2 84-in. balanced pressure	Pelton Water Wheel Co
Penstock butterfly valves, 2 156-in. dia, hydraulically operated	Westinghouse Electric Corp
Transformers, 4 25,000 kva, single phase, 11.5/240-kv Y	Allis-Chalmers Mfg Co
Low-voltage switchgear 15-kv metal-enclosed cubicles with four 1000-mva compressed air circuit breakers	Westinghouse Electric Corp
High-voltage switchgear, 2 230 kv, 800 amp, 2500-mva oil circuit breakers	Pacific Electric Mfg Corp
Cranes, 2 110-ton main and 15-ton auxiliary	Judson Pacific Co

AIEE PANEL MEMBERS: A Schmidt *GE*, I R Smith and L A Casanova *Westinghouse Elect*, Dr C H Willis *Princeton*, H C Steiner *GE*, L Keltz *ITE*, H Winograd *Allis-Chalmers*

HOW RECTIFIERS WORK

Look upon rectifiers as selective electric valves. They allow only positive portion of ac wave through to positive side of dc bus. Negative half of wave is either completely blocked or fed to negative dc bus.

With mercury-arc rectifiers this valve action comes about since electrons will normally flow only from mercury-pool cathode to graphite anode. On next half of cycle current flow stops—no electron flow from anode to cathode.

Full-wave rectifier uses both sides of ac wave, either by grouping units or inherently as in mechanical rectifiers.

POWER RECTIFIERS: Many Types Join

Mercury-arc units continue to supply biggest chunk of today's dc needs. Metallic and mechanical rectifiers find wider uses. Germanium, a newcomer, shows promise. The recent AIEE Rectifier Conference* served as a background for this article

► ELECTRIC POWER TODAY is generated, transmitted and distributed as ac. Basic reason is inherent voltage flexibility. Bulk of this generated power is consumed in the form generated, as ac. But many applications (electro-chemical, electric railways, rolling mills, etc) need or prefer dc. Years back these needs were met by generating dc directly or converting from ac with mg sets or synchronous converters.

Rectifier Growth. About 50 years back Peter Cooper Hewitt developed the mercury-arc rectifier. For some 20 years their application in this country was generally limited to converting ac to dc for battery charging and series street lighting. Glass-bulb tubes with low current ratings were used.

Metal-tank, watercooled, high-current rectifiers have been used in Europe since 1911. They were introduced in this country in 1924. Since then, their application on this continent has grown steadily, out-running rotating converters in most fields. Right now, total capacity of mercury-arc rectifiers is about 7 million kw in United States and Canada.

Advantages. Let's consider the mercury-arc rectifier apart from other rectifying units. Its wide acceptance can be traced to good operating characteristics, continued performance improvement and development of new types. Following are a few reasons why they've out-matched rotating machines for most applications.

First they are *static*. That means quiet operation, no need for special foundations or vent ducts. They can be installed in spots unsuited for rotating machines. *Switching* is simple. They can be turned on and off like a transformer, need no synchronizing or polarity checks. Parallel operation and remote or automatic control is quite practical. *Voltage and current* output can be easily controlled since they have no mechanical or magnetic inertia.

Frequency of power source is no problem. Rectifiers are relatively unaffected by system disturbances. Furthermore, they won't feed any current to short circuits on the ac system. *Faults* can be cleared quickly without damage. Where service is essential, protective devices will clear rectifier arc-backs without interrupting service. *Efficiency* is relatively high over a greater part of load range. Idling losses are low. *Costs* for operation and maintenance are low.

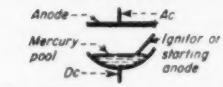
Single-Anode Types. Before 1937 all commercial mercury-arc rectifiers were the multi-anode type. These had 6, 12 or 18 anodes per tank. Development of the more efficient single-anode rectifier (first the *ignitron*, later the *excitron*) broadened application in lower voltage range: 200 to 300 v. Pumpless sealed tubes pushed practical application to still lower ratings. Now let's look at some of the major fields where mercury-arc rectifiers are used today.

Railway Service. This was the first and for many years the largest field. High efficiency at light loads was a big consideration in choosing rectifiers over rotary (synchronous) converters. Railways generally have a low load factor. Automatic control and quiet operation meant they could be installed in residential areas.

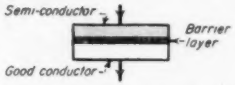
Most installations are on 600-v urban railways. Others feed 600-, 1500- and 3000-v suburban and interurban lines.

* Conference on Electronic Converter Applications and Tubes, Pittsburgh, Pa. May 19-20. Most of the material here published is based on papers presented by Panel Members shown above. Panel session was but one of four sessions held during Conference. All Conference papers are being reprinted in booklet form and will be available through AIEE.

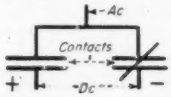
BASIC TYPES



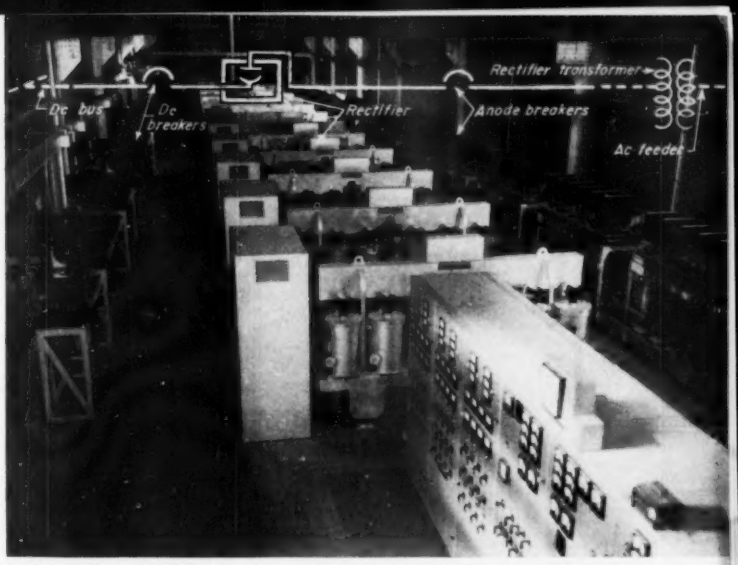
Mercury-arc needs arc-starting method. Can either be ignitor dipped in mercury pool or small anode holding arc on surface



Metallic rectifiers will conduct current in one direction only



Mechanical units use contacts to pick off each half of wave



MERCURY-ARC RECTIFIERS banked parallel on dc bus. Stepdown transformers feed anodes atop each bank through circuit breakers. Cathodes feed dc positive bus

Mercury-Arc to Meet Expanding Needs

Largest rectifier installation was made in New York City's subway system. Total capacity is about 330,000 kw. Most of these rectifiers are in underground substations, supervisory controlled from system operator's office. Substations are adjacent to the subway tunnels.

Railway field has been shrinking rectifier-wise. One reason is wider use of buses, especially in smaller cities. In the main-line railroad picture, much planned electrification work was shelved by growth of diesel-electric locomotive.

Electrochemical Industry. Between 1938 and 1943 the electrochemical industry became by far the largest user of mercury-arc rectifiers. This industry is still expanding. Here rectifiers help produce, to mention a few, aluminum, magnesium, zinc, copper, sodium, chlorine, hydrogen, hydrogen peroxide. Biggest chunk from the capacity angle is in aluminum and chlorine.

In electrochemical work the load circuit has many electrolytic cells in series. Current is the same in all and is held nearly constant. Load factor is close to unity. Voltage ranges anywhere from 250 to 1000; usually over 500 v.

For chlorine plants, currents per circuit range anywhere from 7500 to 30,000 amp; aluminum potlines take 50,000 to 100,000 amp. Rectifiers operate in parallel to supply these high currents. Each unit supplies 4000- to 6000-amp.

Mercury-arc rectifiers are well suited for electrochemical work. Stability during power interruptions, plus ability to restart quickly afterwards, are major factors. Electrochemical industry should continue as biggest user of rectifiers.

Because of a specific power-supply problem, several large dc power-generating plants were built or are under construction. These supply power for aluminum production. Total capacity is about 500,000 kw. These plants use natural-gas engine-driven dc generators.

Industrial Service. Single anode and sealed-tube units helped push rectifiers into general industrial applications. They supply constant-voltage dc power in steel mills, foundries, smelters, paper mills, rubber mills, printing plants, metal-fabricating plants. The dc power feeds cranes, conveyors, electromagnets, ore and coal-handling equipment, machine tools and other dc motor-driven equipment. Adjustable - speed drives have increased application of dc motors, hence greater need for rectifiers.

Rectifiers have generally superseded mg sets for these applications. Reason is (1) higher all-day efficiency (2) easy operation (3) possible location close to load centers. Units generally rated between 150 and 2000 kw. Factory-built unit-type substations with sealed tubes for ratings below 600 kw.

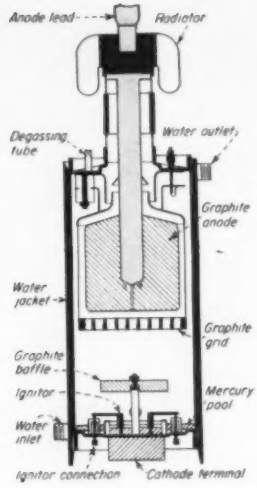
More recently, rectifiers have been used for main roll drives in steel mills. For this application alone, total capacity in this country is now about 90,000 kw. Units range from 3000 to 6000 kw at 600 or 700 v.

Other Applications. Plus the applications mentioned above, rectifiers feed dc power to large turbine-generators and synchronous condensers. Rectifier tubes have been mounted in electric locomotive to convert ac to dc for traction power. They're also used to supply high-current pulses to electromagnets of high-power particle accelerators found in nuclear research.

There's an interesting if limited application in electronic frequency converters. Here rectifiers connect 25- and 60-cycle power systems. Frequency changers form a flexible nonsynchronous tie between power systems through a dc link. In operation, power from one system is converted to dc through a rectifier, then transferred to the other system through an inverter. There are but two such installations. Both belong to U. S. Steel: one a 20,000-kw unit at the Edgar Thomson plant, the other 16,000-kw in the Gary plant.

To now, we've discussed mercury-arc rectifiers. They represent by far the bulk of installed power-rectifier capacity. But there are other type power rectifiers; hot-cathode tube, metallic and mechanical. Each, along with the different types of mercury-arc units, will be considered on the next two pages.

Single and Multi-Anode Mercury-Arc Rectifiers...



IGNITRON

An ignitron is a single-anode mercury arc rectifier. Its distinguishing feature is a small stationary electrode, immersed in the cathode pool. This ignitor starts the cathode spot. Once cathode spot is established at mercury surface the main anode can pick up and conduct in one direction.

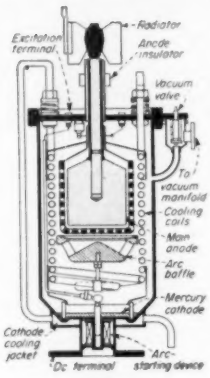
Description. In appearance the ignitron has a cylindrical steel tank, a mercury pool on bottom, a heavy graphite main anode and the small ignitor.

Ignitor is a slender rod of low conductivity. It is not wet by mercury. To start cathode spot a high-current is passed through ignitor into the mercury pool. This vaporizes mercury at ignitor's surface. High-voltage gradient at mercury surface starts cathode spot or arc, giving off electrons. Cathode spot is maintained by main anode current ordinarily flowing less than one-half cycle.

As in all mercury-arc rectifiers a high-degree of vacuum is needed. Low-capacity units are generally pumped out during manufacture and sealed at factory. These are called sealed or pumpless unit. Larger rectifiers are often permanently connected to a pumping system.

Accessories. An ignitron unit is a group of ignitron tanks, auxiliary equipment, transformers and switchgear. Auxiliary equipment includes components for ignitor excitation, temperature regulating, vacuum, and possible anode heating.

Rating and Efficiency. Single-anode rectifiers have current ratings from 100 to 1000 amp at 250-v dc. High-voltage-unit designs range from 50 to 150 amp at voltages to 18 kv.



EXCITRON

Voltage regulation is similar to shunt machine. Voltage drop from light- to full-load is 5 to 7%. Most favorable application is to supply constant voltage power at dc voltages over 200. Where voltages drop below 200, rectifier's efficiency falls rapidly.

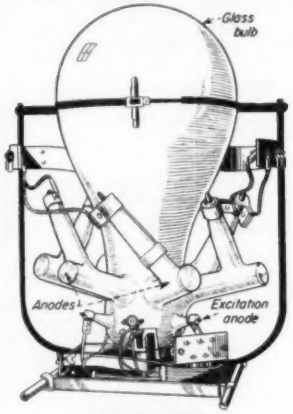
One feature that sets the *excitron* apart from the ignitron is method of creating the cathode spot. Here the spot is maintained continuously on mercury surface, while rectifier is operating by a pilot arc from excitation anode.

Excitron rectifiers have been in commercial operation since 1941. Total capacity is now about 400,000 kw. Output voltages range between 230 and 1750. Capacities run from 150 to 8000 kw.

Cooling. As in all mercury arc units, provision must be made for carrying off heat developed in tank. In the excitron the stainless steel cooling coil is insulated from tank. In addition to carrying off arc losses it shields tank wall from arc. This shielding prevents transfer of arc from cathode pool to tank wall.

Assembly. Like the ignitron this unit is assembled in a group of 6 or 12 tanks, depending on rating and number of phases. Copper bars connect all cathodes to form positive side of dc system.

Applications. In general the field of application is similar to that of the ignitron. They can be used for industrial, electrochemical and transportation service. Excitrons have been used in steel mills, rubber mills, office buildings, and in mining, transportation and industrial service.



GLASS-BULB

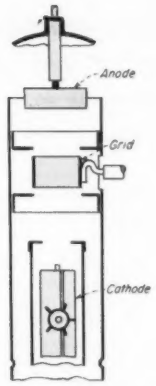
Rectifier above is a multi-anode unit. All anodes are contained in the one glass bulb. This type is used widely in Canada and Europe. Briefly, this rectifier is a glass vessel, highly evacuated except for mercury vapor. Within bulb are main anodes, cathode pool of mercury, starting and excitation electrode.

European Practice. Among the new designs in glass-bulb units is a 3-anode unit with all anodes in one quadrant. In that way four 165-amp bulbs can be compactly grouped in a 54-in. square cubicle, giving an over-all rating of 400 kw at 600 v. It seems to be a fundamental principle, especially among British manufacturers, that the average anode current shouldn't exceed 60 amp. Four such cubicles using 16 bulbs make up a 1520-kw 600-v railway substation with a floor area of only 90 sq ft. In sharp contrast to practice in this country, cooling is by direct air; a fan placed directly under the bulbs.

Cooling. Water cooled rectifiers in service are practically all using water-to-water heat exchangers. Water costs dictate this practice. Many air-cooled units have water coolers placed right in the air stream. In such cases the buildings are completely closed to avoid need for air filters.

Trends. One reason for the widespread use of glass bulbs rather than steel tanks in Europe is the high cost of materials compared to labor. Taking a typical 200-kw glass-bulb unit, the materials cost will be $30 for glass, $50 to $75 for carbon and $30 for mercury. It takes about 40 man-hours to build the bulb.

...Plus Hot-Cathode, Metallic, Mechanical Units Round Out Power Picture



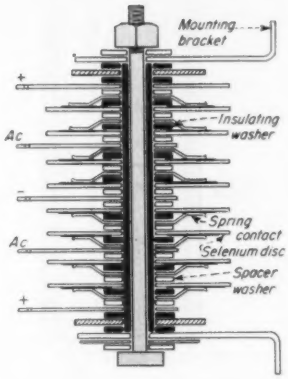
HOT-CATHODE

If a cold and a hot electrode are sealed in an evacuated bulb, you have the basic elements for a hot-cathode rectifier. If a positive potential is applied to cold *electrode, it* will collect electrons given off by heated cathode. This is the valve action of a rectifier at work. The *thyratron* is a typical example of a hot-cathode unit.

Design. Tube elements are an oxide-coated cathode electron emitter, mercury vapor, an anode for electron collection and a grid for electrostatic control. Grid control differs from that in the usual high-vacuum tube since the grid can prevent arc starting. But once started, grid exercises little or no further control. There's a trend toward fast-heating cathodes. Aim here is to eliminate time-delay relays and controls.

Application. Thyratron tubes have become part of industrial electronic control and power-conversion equipment. These tubes can control currents in the order of amperes with low arc losses. Low-arc-loss feature means they can work efficiently in 110- and 220-v circuits. Primary job of a thyratron is to give a variable-voltage dc output for relay, saturable reactor, or motor-field or armature control.

Experience shows the best performance and longest life come when cathodes are continuously energized. Frequent starting and stopping tends to induce expansion strains in tube. Best operating practice calls for keeping cathodes energized. An exception would be where nonoperating periods exceed 6 to 8 hr.



METALLIC

Today there are three well-known types of metallic rectifiers in use for power conversion; *magnesium-copper sulfide, copper oxide,* and *selenium.* A newcomer to this family is the *germanium* rectifier, now available rated 25-kw 125-v dc at 200 amp.

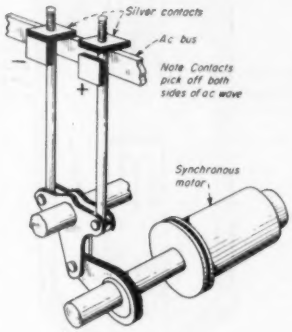
Design. Basic elements of any metallic rectifier are a good conductor, a poor or semi-conductor, and a barrier layer region. In magnesium-copper sulfide rectifier, the good conductor is magnesium, the semi-conductor copper sulfide. For the copper-oxide unit, the good conductor is copper, the semi-conductor copper oxide. In selenium rectifier, the good conductor is alloy coating, the semi-conductor selenium.

The barrier layer is always about at junction of the two conductor types. *Current flows more readily from semi-conductor to good conductor.*

Advantages. Features of selenium cell and metallic rectifiers, in general, are greater ruggedness, no filament excitation, no time delay in operation, long life and high efficiency.

On other side of ledger are some definite disadvantages. Compared to tubes they are likely to cost more, have poorer voltage regulation, do not have advantages of grid control, are not as efficient at higher voltages, weigh more and take up more space.

Application. Field of use may be broadly given as high voltage—low current, medium voltage — medium current, low voltage at all current. Typical applications are in battery charging, electrochemical industry, high-voltage rectification for precipitators, resistance welding.



MECHANICAL

Rectifying element is a set of metallic contacts driven by a synchronous motor. Dc is produced by connecting ac and dc systems when ac sine wave is in desired direction. Contact is then broken when the ac phase reverses. Mechanically, the rectifier is a motor-driven switch connecting and disconnecting ac and dc system so current flows one way.

Design. One can immediately see mechanical limitations in trying to close and open contacts only when the ac wave is passing through zero. The problem would be one of timing so contacts make and break at current-zero.

This fundamental drawback is licked in today's commercial mechanical rectifier with the commutating reactor. By inserting a saturable reactor between transformer terminals and ac bus, the zero-time point is stretched.

Ratings. At present the mechanical rectifier is built to deliver from 3000 to 10,000 amp in a single unit. Several units can be paralleled on a common bus. Voltage range is from 50- to 400-v dc.

Applications. The mechanical rectifier is more efficient than any other available conversion equipment. At present the unit is primarily applied in the electrochemical field. Units cannot accept regenerative loads. Where backfeeds are possible, special precautions must be taken.

At present there are 14 units in operation. Experience shows that further improvement must be made to extend contact life. With exception of contacts no mechanical parts have ever been replaced.

9 Mufflers to

You have a wide choice of mufflers for your diesel plant. Here are some that may fit your engine needs

By TYLER HICKS,
Associate Editor

► LAST MONTH we learned how noise originates in diesel and gas-engine plants and the characteristics of different sounds (see POWER, July, p. 86.). Now we're ready to take a look at some mufflers used today to cut noise.

Air-Cooled. Modern mufflers are classified in a number of different ways by makers. Terms like baffle, resonating and 3-pass muffler describe the internal construction of the unit. But since there are various arrangements of baffles and passes, these terms are somewhat general. So we'll stick to certain specific terms here because they help us understand actual units.

Fig. 1 and 2 show two air-cooled mufflers. Unit in Fig. 1 is designed for 2-cycle engines. Hot gas enters lower chamber, Fig. 1, reverses flow direction, leaves through perforations in primary chamber. From here it rises through central tube to secondary chamber.

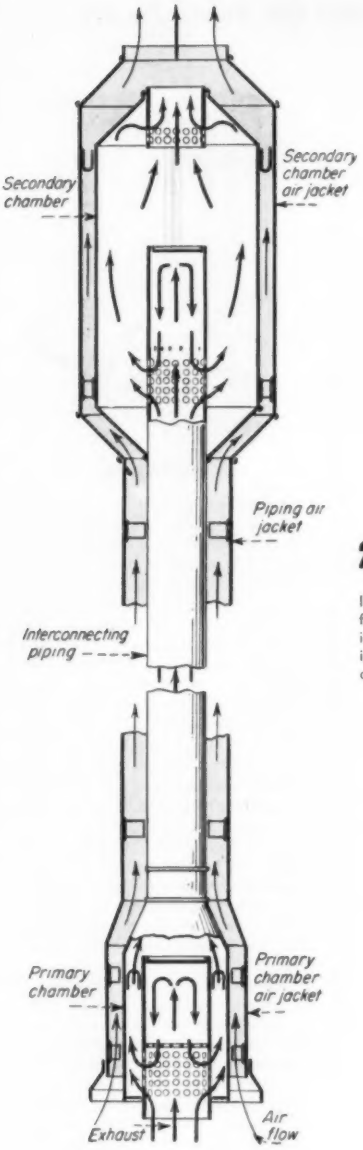
Air from engine room flows through annular space between muffler chambers and air jacket. From 10 to 15 air changes per hour are produced in engine room by air that flows out to cool gas in muffler. Muffling efficiency is good. This unit is especially suited to 2-cycle crankcase-scavenged engines.

Unit in Fig. 2 has similar air-cooling passages but inlet nozzle and vertical baffles replace perforated pipe.

Offset Tubes. Another design with many variations, Fig. 3 shows one type that snubs gas slugs, decelerating the wave front that causes noise. Such units are available for industrial silencing levels or critical installations like hospitals, hotels and office buildings.

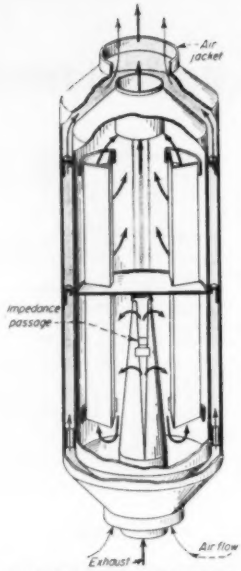
Fig. 4 and 5 show two silencers suitable for various applications. Unit in Fig. 4 is for 2- and 4-cycle engines in localities that need effective though not complete silencing. Silencer in Fig. 5 provides the highest degree of noise reduction, meets critical needs.

This unit reduces engine exhaust noise in two ways: (1) Baffling of chambers cuts the "bang" noises. This noise reflects around inside the first chamber, losing a great portion of its energy be-



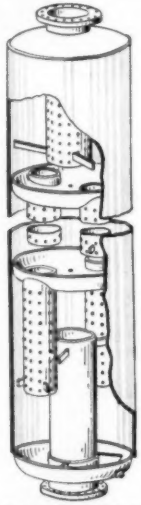
DUAL-ELEMENT AIR-COOLED

1 Designed particularly for 2-cycle crankcase-scavenged engines, this muffler has two silencing chambers connected by central tube. Air from engine room is used to cool central tube and the two chambers, primary and secondary. From 10 to 15 air changes per hour are produced in engine room by the unit



SINGLE-ELEMENT AIR-COOLED

2 This unit is for 4-cycle engines. It features nozzle arrangement to give an impedance match to improve silencing efficiency. Air cooling keeps muffler shell temperature down, prolonging its life. Temperature of exhaust gas leaving muffler is lower than without cooling, and there is no lagging on the exterior



PERFORATED MULTI-TUBE

3 Gas slugs leaving engine build up a steep wave front, which causes noise when it strikes atmosphere. Quick succession of these slugs causes roaring noise. This unit snubs gas slugs, decelerating the wave front. Depending on design, units like this are suitable for industrial- to critical-silencing levels

Cut Diesel Noise

fore it passes through deresonating baffle tubes into next chamber, where remainder of noise is dissipated.

(2) Resonant noise made by exhaust pipe travels as a shock wave to slotted inlet tube. This tube eliminates an abrupt ending of the exhaust pipe and prevents reflection back into pipe, upon which resonant noise partly depends. If reflection back into pipe doesn't take place at outlet when shock waves reach it, pipe won't resonate. Slot in side of inlet tube gradually reduces shock-wave pressure coming from engine. Here again, resonant noise is reduced by passage from chamber to chamber.

Spark Arresters. First section of unit in Fig. 6 has a stationary impeller that throws out sparks, soot, ash. Cleaning efficiency is extremely high. Whirling gas leaving impeller passes through vertical vanes that straighten flow before perforated outlet tubes of snubbing section are reached. Gas leaves unit in a steady, quiet stream without sparks.

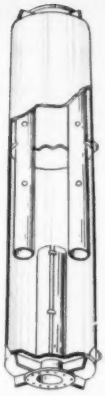
In another design, Fig. 7, gas enters side of unit. Water jet may be mounted in top head. Fine spray extinguishes sparks and flame in engine exhaust. Water spray makes gas engines safer.

Spark-arrester silencer in Fig. 8 finds much use in refineries, plants with dusty conditions that are explosion hazards, and wherever dirt must be avoided. Sparks and carbon particles are whirled before being thrown into the cone that deposits them at bottom of unit. It is good for all 4-cycle and most positive-scavenged 2-cycle engines.

Fig. 9 shows another spark-arrester silencer design, using centrifugal force to separate sparks and carbon particles from gas. This, like most other units that remove sparks, can be fitted with a spark box to collect separated particles. Most units may also be made with handholes for easier cleaning.

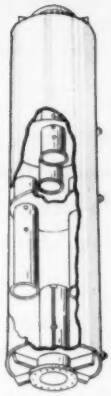
Installation. Rules of thumb for exhaust-pipe size, distance of silencer from engine and tail-pipe length are often given. But unless you have wide experience with engine or silencer design, steer clear of trying to pick a unit without manufacturer's advice.

Picking a silencer may be likened to a triangle. At one apex, we have the engine user and his noise reduction needs; at another, the engine manufacturer with his backpressure limits. At the third is the silencer manufacturer who has size, material and cost limits. Only when major requirements of all are met is the installation satisfactory. You can insure good results in your plant by watching the triangle apexes.



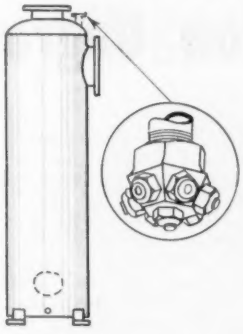
INDUSTRIAL SILENCER

4 For effective but not complete noise reduction of 2- and 4-cycle engines, this unit does a good job at low cost



HIGH-DEGREE SILENCER

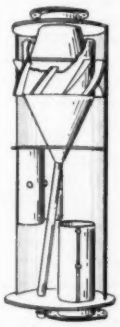
5 Slotted and perforated tubes reduce noise to within limits of critical installations like hospitals and hotels



MANY SPARK-ARRESTER SILENCERS WHIRL GAS . . .

6 Stationary impeller throws out soot, sparks and ash. Cleaning efficiency approaches 100%; noise reduction good

7 To insure positive extinguishing of sparks and flames this unit can be fitted with water spray in the top head



. . . TO SEPARATE SOLID PARTICLES FROM IT

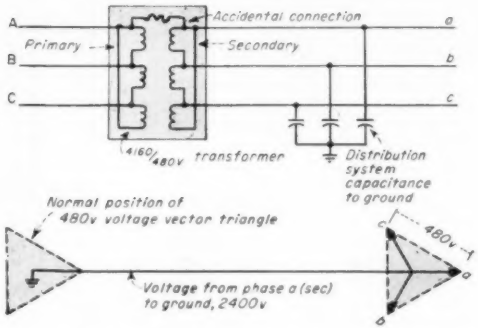
8 Spark-arrester silencer like this may be used in hazardous locations or in places where dirt or dust is a nuisance

9 Medium high-degree silencing, 100% spark arresting are obtained with this unit. Removable spark box optional

Overvoltage Can Stem From Direct...

Overvoltage beats the life out of electrical insulation. Here are causes for this high line-to-ground voltage. Best solution is grounding distribution system neutral

By R H KAUFMANN,
Industrial Power Div, General Electric Co



1 Accidental connection between high- and low-voltage means low-side voltage to ground is upped to the high-side value

How Ungrounded Distribution Systems

► ALONG ABOUT MIDAFTERNOON in a West Coast industrial plant, trouble started popping in the electrical-distribution system. First sign was a motor failure in the 480-v ungrounded distribution system. Other motor failures followed in quick succession. A fast check of switchboard line-to-line voltmeters and circuit ammeters gave no clue. Motor insulation continued to fail. To trace the trouble a test voltmeter with a full-scale deflection of 1200-v was connected between one phase and ground. The pointer went off scale. That meant a line-to-ground voltage greater than 1200! But how come, when line-to-line voltage was only 480?

First thought was of the incoming service transformers. They might have broken down between high- and low-voltage windings. One by one these transformers were isolated and individually tested. They were not at fault. Yet equipment continued to fail. The situation was getting desperate.

Then came the first real clue. A wisp of smoke was noticed coming from a motor-starting autotransformer. It sounded like a beehive inside. When this circuit was switched clear, overvoltage disappeared. And here's the motor toll: During the 2-hour period this arcing-fault existed, between 40 and 50 motor windings had failed!

The autotransformer case on this motor starter had been accidentally bashed in, was almost touching the coil. Spot where arcing had taken place was evident although not badly burned.

To prove to the plant engineer that a sputtering ground caused the overvoltage, the frame was solidly connected to coil's burned spot. Sure enough, voltage between the two ungrounded phases and ground showed but a relatively small increase. Main ingredient of the overvoltage—discontinuous conduction—had been eliminated.

Overvoltage Sources. Looking back, much has been learned in the past ten years about cause of overvoltages in industrial distribution systems. This increased knowledge stems from results of transient network analyzers, conventional analytical studies, operating records. Many overvoltages that were baffling a few years back are now explained in simple language.

There are many sources of overvoltage. Those that can occur in industrial systems include lightning, switching surges, static, contact with a higher voltage circuit, extended windings in autotransformer applications, resonant inductor-capacitor (L-C) circuits, inductive line-to-ground faults, intermittent ground faults (sputtering ground).

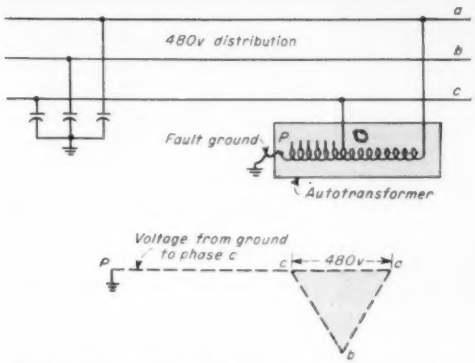
Lightning can be a major source of overvoltage on unprotected exposed circuits. Fortunately the majority of industrial-plant distribution systems are not exposed to lightning or are well-protected with lightning arresters. *Switching surges* come from opening or closing feeders. Usually overvoltages from switching are minor. *Static* is rarely a source of overvoltage in modern metalclad systems. Belt-static may find its way to distribution feeders if motor frames are not grounded.

High-Voltage Contact. Accidental connection between high- and low-voltage systems, Fig. 1, can cause high overvoltages on the lower voltage system *when the latter is not grounded*. Typical would be an insulation breakdown between high- and low-voltage where both are carried on the same pole. Overvoltage can also result from transformer failure, between high- and low-voltage windings.

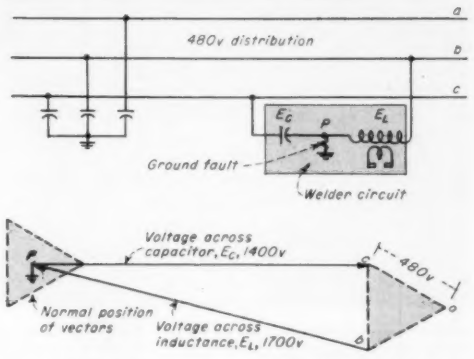
Accidental bridging of high and low voltage means both conductors come to same potential above ground. And if low-voltage system is not grounded, phase-to-ground voltage on low-side will be upped to that of high-voltage side. Neutral grounding pins down voltage between any phase and ground on low voltage side. If this voltage is exceeded the circuit protective devices will operate.

Stepup autotransformers and multitapped transformers can be the root of dangerous voltages in ungrounded systems, Fig. 2. Note that induced voltage per turn in overhanging portion equals that in excited part. So if point *P*

...Contact, Transformer Grounds and Inductor-Capacitor Circuit Faults



2 If point *P* on the far side of a stepup autotransformer grounds, voltage to ground is sum of volt-drops in winding



3 Overvoltage here can be traced to the high-voltage built up across capacitor, inductor in series and near resonance

Develop Line-to-Ground Overvoltage

grounds accidentally, resulting line voltage to ground is sum of voltages in both portions of transformer winding. Phase-to-ground voltages throughout supply system will increase. If neutral is grounded, a line-to-ground fault at *P* simply means overloading local autotransformer circuit. System voltage to ground stays constant.

Resonant L-C circuit. Where a capacitor and inductor of near equal values are in series, there is a possible source of serious system overvoltages if neutral is ungrounded. Such an L-C setup is found in a series-capacitor welder, Fig. 3. The hookup is used to reduce system demand and keep power factor up. Line-to-ground overvoltage trouble pops up if midconnection between capacitor and inductor accidentally grounds. A rare occurrence, but it can happen.

As in any near-resonant L-C circuit, voltage drop across capacitor and inductor portions are each several times the line-to-line voltage. And they're close to 180 deg out of phase with each other. Should point *P* become grounded, in an ungrounded supply system, the complete system vector voltage will be displaced, bringing *P* to ground potential. Result here, Fig. 3, will be line-to-ground voltages of 2100 v on phase *A*, 1700 v on *B*, 1400 v on C.

With neutral grounding a ground fault at *P* merely reduces voltage on welding transformer primary to 277 v. Only result is failure to produce a satisfactory weld on this single welder until fault is corrected.

Capacitive Coupling. Now we meet two sources of overvoltage that come into the picture because of capacitive coupling between system conductors and ground. That means all power cables, bus structures, rotating machine windings, transformer windings, etc. Their collective values fix total system-to-ground capacitance.

Line-to-ground capacitance is generally the same on all three phases. Voltage from line-to-neutral in the unfaulted system (across capacitive-coupling) is line-to-line voltage divided by 1.73. Let's assume phase *A* accidentally grounds. System voltage-vector triangle will not change its shape. But it will be displaced to bring phase *A* conductor to ground potential. The simple single-line equivalent circuit in Fig. 6 correctly represents an accidental ground on a 3-phase ungrounded system.

An inductance, resistance or capacitance can be met in line-to-ground faults. But it's only the connection of inductive reactance that results in dangerous overvoltages. Simply the series inductor and capacitor circuit again. High overvoltage is result of near resonance between inductive reactance and system capacitive reactance to ground.

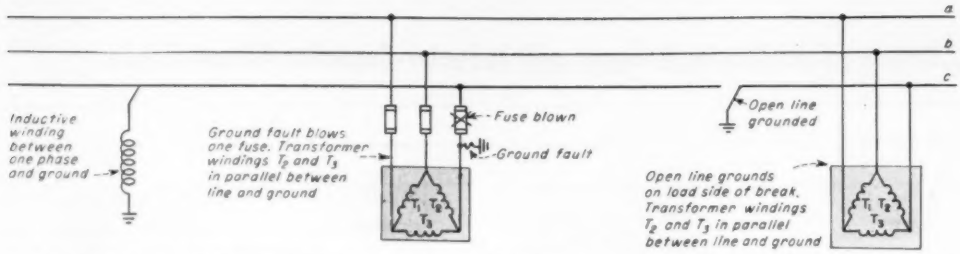
There are many ways a high-reactance circuit can be formed between line and ground. Fig. 4 shows how reactance of transformers may become connected phase-to-ground.

Sputtering Ground. But what about that overvoltage problem in the West Coast plant we mentioned? There, overvoltages developed because of a sputtering ground on one phase. To understand it, take a deep breath and glance at Fig. 7 (next page). This sketch is in four parts. Each part shows the voltage relation between any of the phases and ground as the voltage vectors rotate.

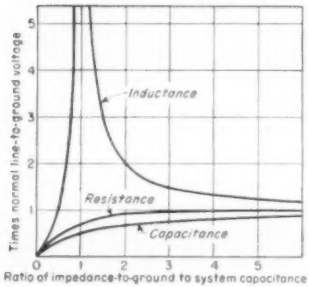
Part 1 in this sketch shows the normal voltage vector pattern. System is ungrounded, hence neutral is at ground potential through system capacitive coupling. The 3-phase voltage vectors are symmetrically spaced and swing around the neutral *N* at synchronous speed—as they should.

Part 2 shows change in vector position when phase *A* accidentally grounds. Immediately, entire voltage vector triangle is shifted upward, bringing *A* phase to ground potential. There will be a small ac charging current flowing, possibly 0.5 amp. Actually, when the *A* phase voltage reaches its negative peak the charging current to ground will be passing through zero. That's because current in a capacitive circuit is out of phase with the voltage.

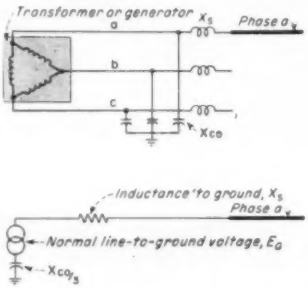
If there's a small gap at point of fault, this zero-current point is most likely spot for a current shutoff. In-


a
b
c
Inductive winding between one phase and ground
Ground fault blows one fuse. Transformer windings T_2 and T_3 in parallel between line and ground
Fuse blown
Ground fault
Open line grounded
Open line grounds on load side of break. Transformer windings T_2 and T_3 in parallel between line and ground
T_1 T_2 T_3

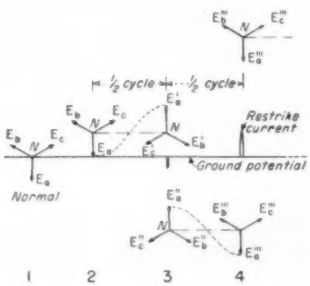
4 A few of the ways a high-reactance circuit can be formed between line and ground. Transformer windings are the inductances that connect in series with system capacitance. This capacitance exists between cables, machines and ground



5 Inductive reactance circuit fault raises voltage when near resonance



6 Lining up the basic circuit elements for equivalent circuit on one phase



7 Fault restrikes shift voltage vectors, increasing the line-to-ground voltage

Sputtering Ground Can Zoom System-to-Ground Voltage

terruption is easy since no recovery voltage appears across the gap at current shutoff. Reason for lack of recovery voltage is the dc voltage to ground that's trapped in the system-to-ground capacitance.

Part 3 in same sketch shows vector location when generated voltage in *A* phase reverses in the next half cycle. Voltage vectors are now in the position in upper section of part 3 (still Fig. 7). During that half-cycle interval, *A* phase potential to ground followed the dotted line shown. Note the voltage between phase *A* and ground is now twice normal.

If fault-gap breaks down again, as it probably will because of the high momentary voltage between phase *A* and ground, phase *A* potential tends to shoot back to ground potential. But because of the capacitance and inductance in the circuit, *A* phase potential tends to overshoot the ground-potential axis. It will assume position in lower section of part 3. Remember, this overshooting is key to high overvoltages on sputtering grounds in ungrounded systems. And it overshoots the ground-voltage line because fault involves circuit inductance and system capacitance. Position above or below ground line indicates magnitude only, not polarity or voltage direction.

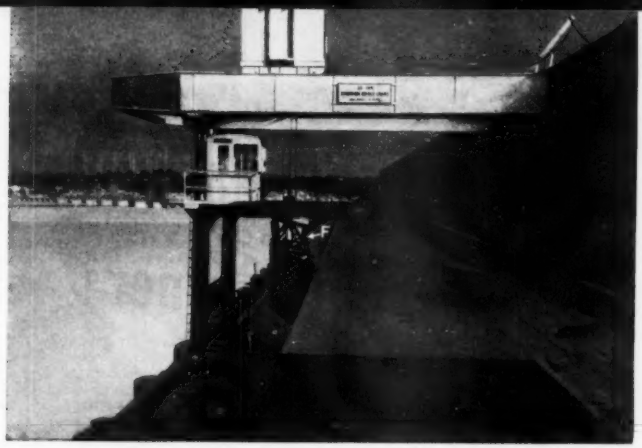
Part 4, lower sketch, shows vector relationship when phase *A* has rotated to maximum negative position. Once again voltage is ready for a shift to a higher value. When the fault restrikes and seals off at the next current zero, the voltage-vector triangle will be propelled to position in upper sketch, part 4, in about the same manner as in part 3.

We are talking about an "ideal" condition. But it proves the possibility of producing overvoltages of eight times normal in less than two cycles. In the practical circuit the ground fault may reconduct before reaching maximum phase-to-ground potential. This decreases magnitude of high-frequency voltage oscillation. Further, arc extinction may not occur at first current zero of transient restrike current. This means the transient oscillation may partly decay. Build-up of overvoltages will occur at a reduced rate and tend to reach a ceiling value. System records indicate voltages over 6 times normal are rare. Neutral grounding, either solid or through resistance, is a good solution.

Plants that have grounded their neutrals following a period of operation, report better performance with a lower fault outage rate than before. In addition, grounding of system neutrals means balanced voltage stress on all phases during normal operation. Further, it assures protection from overvoltage sources, at same time, taking full advantage of other desirable properties of grounded systems, like reduced fault damage, prompt clearing of a faulty system element, improved unit protection.

Automatic Hooks Lift Head Gates SAFELY

To save manpower and eliminate the hazards of handling head gates, one hydroelectric plant uses a follower that automatically latches and unlatches the crane from gates



GANTRY CRANE. On this 25-ton crane a follower, which is operated by a torque motor from pushbuttons, handles the head gates at this large hydroelectric plant

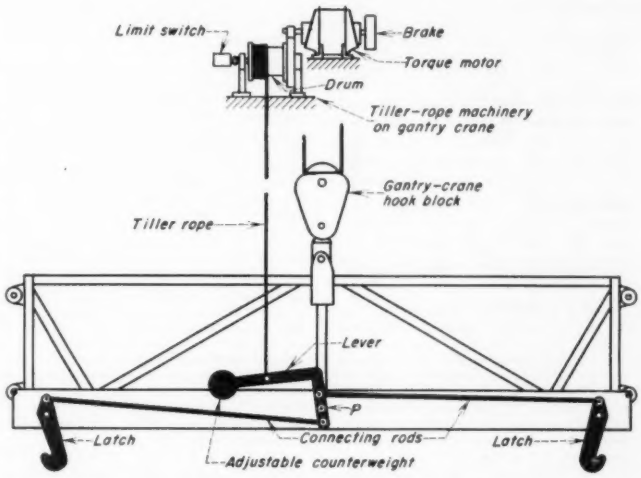
► On the Ottawa River at the Chenaux plant of the Hydro-Electric Power Commission of Ontario, the 25-ton headworks gantry crane handles the rack sections, the stop logs and head gates. It also has an auxiliary high-speed hook for operating the trash-rack rakes.

A standard head-gate crane requires a man to follow along the dam to connect the crane hook to the gate to be lifted. Making this connection is a dangerous job, particularly in winter when everything may be covered with snow and ice. To eliminate this hazard and save manpower, the Dominion Bridge Co developed a device to lift the head gates at Chenaux plant by follower *F* in the photo, which hangs from the main hook of the crane. A hook or latch at each end of the follower automatically engages a gate when the follower is lowered onto it.

The latches are operated by a tiller rope that winds on and off a drum driven by a torque motor, mounted on the trolley frame, as in the diagram. From the drum the tiller rope connects to a counterweighted lever pivoted at *P* in the follower. Free end of this lever, through connecting rods, attaches to the top ends of the latches.

When the tiller rope lifts the lever, it moves the hook ends of the latches toward each other to release them from the gate. When the tiller rope is released the counterweight lowers and through the lever and connecting rods moves the latches apart to engage the gate for lifting.

A pushbutton-operated magnetic-reversing starter controls the torque motor. This control gives low-torque normal running to wind up the tiller rope's slack. High-torque short-time running is available to raise the counterweight and lever to release the latches. Low torque is developed during reverse running to lower the tiller rope for connecting to the follower when changing from crane-hook to gate lifting service.



GATE LATCHES. When the torque motor winds up the tiller rope, it releases the latches. Lowering the rope connects the follower to gate for lifting and lowering

When operated to release the gate latches the torque motor gives a pull of about 200 lb on the tiller rope. A magnetic brake and geared limit switch prevent overwinding the tiller rope when the crane is being used for hook service without the follower. During these periods the tiller rope is disconnected from the latch lever and wound up on its drum clear of the hook block for other services.

Chenaux is one of three great plants of over 900,000-hp total capacity that the Hydro Commission is building on the Ottawa River. Two of them, Des Joachims and Chenaux, are now in operation and La Cave goes into service this year. Chenaux has eight 21,000-hp Dominion Engineering Works propeller turbines operating at 94.7 rpm under a 40-ft head and connected to 17,000-kva Canadian General Electric generators. This plant is seven miles down stream from Des Joachims, which has 496,000 hp in operation in eight 62,000-hp units.

THERMODYNAMIC Argument Corner

Here's progress report on the reaction of some workers in fields of thermodynamics and fluid mechanics to revisions proposed in March issue

► TRUE TO POWER'S prediction, the new concepts advanced by Professor Neil P Bailey, Rensselaer Polytechnic Institute, have stirred up considerable controversy. The reception has ranged from watchful waiting for more conclusive information to outright rejection. Here we report arguments from those who disagree with his revised theory of fluid flow:

PROF A H SHAPIRO, *Massachusetts Institute of Technology:* It is no pleasure to attempt to refute new ideas, particularly at the risk of being labeled obstructionist. Yet when these ideas are clearly fallacious, arrived at by muddy arguments, and involve violations of well-tested physical principles, and above all when they are advertised in a blatantly commercial manner, it seems just they be answered.

I will confine this discussion to some general remarks concerning the basic concepts involved and a few statements of specific errors.

The erroneous conclusions stem from the basic misconcept that laws of dynamics may somehow be derived or extracted from the laws of thermodynamics, and from misinterpretation of the first law of thermodynamics.

The first error is exactly what Prof Bailey has attempted. That he has arrived at results which violate Newton's laws of motion is, therefore, not surprising. It seems that the article was written without a clear picture of the present subject matter of fluid dynamics, as witness the astonishing statement, "Basic concepts of fluid flow are essentially those of 1850 hydraulics." This ignores the contributions of such men as Prandtl and von Karman, and is contradicted by the present state of the areonautical art. The dynamic principle for flowing fluids, which Bailey apparently is striving for unsuccessfully, is already well known in the form of the momentum theorem of fluid dynamics.

In the second error I am somewhat at a loss for a precise statement because the arguments in the article are so labyrinthine that I had difficulty in following them. The seed from which springs the confusion is not at all uncommon in the thermodynamic literature—a lack of clear distinction between: (1) a collection of matter of *fixed identity*, commonly called a "system" or "free body," and (2) a volume *fixed in space* through which matter passes, commonly called a "control volume." From this lack of distinction arise the many mystifying "explanations" of the pressure-volume product in the steady-flow energy equation. This mystery was dispelled at least 50 years ago, and simple, rational developments of the subject are readily available (see Prandtl-Tietjens, *Fundamentals of Aero- and Hydro-Mechanics*, McGraw-Hill Book Co; Keenan, *Thermodynamics*, John Wiley & Sons; Hunsaker and Rightmire, *Engineering Applications of Fluid Mechanics*, McGraw-Hill Book Co).

This lack of distinction in Bailey's article between a system and a control volume seems to be the reason for the incorrect introduction of the term $Pvda$ in the steady-flow energy equation. Another mistake attributable to the same source is the term Par, called "transmitted energy." Truly, this term represents the instantaneous rate at which mechanical work is delivered via pressure forces by the fluid on one side of an imaginary plane to the fluid on the other side. Unfortunately, this does not seem to be the way Bailey interprets it. The manner in which he brings it into the statement of the first law is incorrect and leads to erroneous results. A further specific example of the confusion between a control volume and a system is that eq (9) is ostensibly (but incorrectly) derived for a stream tube, but in the most important applications, those associated with flow of Fig. 2—the equation is applied to the flow through a control volume, which happens not to be a stream tube as well.

Perhaps the most convincing proof that Bailey's proposed methods are incorrect is to show that they lead to absurd results. In the following example they predict a phenomenon contradictory to physical experience and simultaneously violate Newton's second law of motion, and the first and second laws of thermodynamics. Bailey claims that eq (8) of his article, $(W/g)dv + d(Pa) = 0$, is applicable to the various cross sections of a stream tube in a "space flow," that is, to a stream tube not bounded by solid walls. Let us apply this to an infinitesimal stream tube, which lies on the axis of an axially-symmetric bellmouth inlet that draws incompressible fluid from a large stagnant region and discharges it into a duct.

Radius of the tube wall is infinitely greater than that of the infinitesimal stream tube, and hence the latter meets Bailey's definition of a stream tube in "space flow." Now let us integrate the foregoing equation between a section *1* of the stream tube far upstream of the bellmouth, and a section *2* of the stream tube after the latter is within the duct:

$$(W/g)\ (v_2 - v_1) + P_2a_2 - P_1a_1 = 0$$

But from continuity,

$$a_1v_1 = a_2v_2 = WV$$

Combining and rearranging,

$$\frac{v_2^2}{gV}\left(1 - \frac{v_1}{v_2}\right) + P_2 - P_1\frac{v_2}{v_1} = 0$$

Now, since the velocity at section *1* is vanishingly small compared with that at section 2, it follows that $v_1/v_2 = 0$ and $v_2/v_1 = \infty$. The foregoing equation, therefore, states that if P_2 is finite, then P_1 must be zero; or if P_1 is finite and not zero, then P_2 must be infinite! The same conclusion holds for any infinitesimal stream tube in the flow under consideration. Thus we have the astonishing prediction that an incompressible stream with zero pressure and velocity will, upon entering the bellmouth, find itself with a finite pressure and velocity! One might wish that flow actually behaved this way, for then it would be easily possible to construct perpetual motion machines, but unfortunately this is not the case. The correct answer for the bellmouth problem, at least for steady motion of a non-viscous incompressible fluid, is easily obtained by that ancient but not yet outmoded principle in the dynamics of fluids—Bernoulli's equation, which is violated by Bailey's eq (8).

Bailey may object that the example quoted is really one of "duct flow" and not of "space flow," because of the presence of the solid walls of the bellmouth far from each infinitesimal stream tube. Such an objection would itself lead to absurd conclusions. It would imply that wind tunnel, propeller tunnel and towing-tank tests were all meaningless because of the presence of solid tunnel walls far from the model. And one would question whether the flow past an airplane was not really "duct flow" because of the proximity of the surface of the earth!

Experiments cited by Bailey show that certain common calculation procedures are sometimes in conflict with observations. From this he concludes the principles underlying these calculation methods are invalid, a dangerous conclusion indeed. In the instances cited the failure of exact agreement between experiment and "theory" is not at all the result of faults in the basic laws, but rather the result of introducing into the theory false assumptions concerning the nature of the flow. To take a vividly simple but valid parallel to the examples of Bailey: It it is observed that a feather dropped from the hand does not acquire a velocity given by $\sqrt{2gh}$, may

it be claimed that Newton's laws are incorrect? The following discussion shows that what are claimed to be discrepancies between theory and experiement are in reality the result of overly simplified assumptions concerning the phenomena under consideration.

In the experiments on water flow into a duct through a sharp-cornered entrance it was observed in a certain range of conditions the flow is unstable. This instability, it is inferred in the article, somehow indicates faults in the commonly accepted principles of fluid dynamics. Important considerations, which are essential to an appreciation of this type of flow and are completely neglected in the article, include the following: (1) The flow is far from one dimension in nature. (2) The velocity at the sharp corner tends toward infinity as the result of 3-dimensional effects. (3) Adverse pressure gradients downstream of the corner tend to produce boundary-layer separation and a vena contracta. (4) The low pressures accompanying high velocities near the corner may result in cavitation. The last-named item has often been observed as leading to violent instabilities and to a hysteresis type of pressure-flow curve.

In the experiments on gas flow into a duct through a sharp-cornered entrance similar instabilities were reported. Comments similar to those of the preceding paragraph are applicable here, except that in place of cavitation there is possibility of the formation of shock waves at high speeds. Examination of the data shows that this instability occurred in the experiments when the gas speed was of the same order of magnitude as the speed of sound. The oscillations are in all probability the result of the well-known unsteadiness of the interaction between boundary layers and shock waves.

Experiments mentioned in the article concerning the discharge coefficients of sharp-corner nozzles do not indicate any violation of Bernoulli's law, but simply indicate that if one neglects viscosity, separation and 3-dimensionality of the flow, then the errors in the computed flow are substantial.

Finally, a word on the measurement of stagnation temperature. The article implies that failure of an impact thermometer to read the stagnation temperature indicates a failure of the laws underlying gas dynamics. At best, there are only *two* stagnation points on an impact thermometer where there might be any hope of the gas being brought to rest adiabatically and without shear work. Over the remainder of the surface, virtually the entire surface of the probe, the local surface temperature is the outcome of complicated heat conduction and shear work effects within the viscous boundary layer. Any theory that ignores these effects is in fact unrelated to the desired answer.

E A GOLDSMITH, *The Johns Hopkins University:* Although POWER must have felt honored at being the first to present Mr Bailey's theory, one wonders why he did not choose a more technical outlet for breaking such news on an unsuspecting world. This is not to be glossed over or miaimized. If Bailey is correct, some of our basic scientific tenets have toppled.

The Problem. Bailey states basically that experiments do not jibe with theory and that patchwork has been used to tie reality and theory together. According to him, "Engineering thermodynamics has been concocted from century-old classical thermodynamics and 1850 hydraulics."

One can only say that engineering thermodynamics is not a concoction but an application of classical thermodynamics and fluid mechanics to the scientific problems of everyday life. Age alone is no reason for proper doubt of a theory's efficacy. Indeed, Bailey points out that his revolutionary eq (9) is a form of Newton's second law.

An empirical formula can often be found to satisfy certain experimental data better than theory. This in no way contradicts a proper theory which has stated (a) the system it is analyzing (b) all assumptions made.

Classical thermodynamics and fluid mechanics always do this, whereas Bailey's analysis is often difficult to follow because he neither (a) defines his system and its boundaries, that is, never actually tells us just what his "space flow" is nor (b) states whether his fluids are subject to internal or wall friction.

Where classical theory deduces the ultimate in perfection, which engineers are continually trying to approach, Bailey offers us a theory that at least in one case sets up a median of perfection that has already been surpassed. This is at any rate a refreshing change from the perpetual motion machine.

The Theory. Bailey's statements of the energy equation of steady flow and the first law of thermodynamics are essentially correct. His statement of the latter, however, is only true for reversible processes and other special cases. The very existence of the steady-flow equation is a denial of Bailey's statement regarding classical thermodynamics's restriction to static processes.

From Bailey's eq (5) we can write:

$$d(WE) = W du + W d\,(v^2/2g) + a v dp + a p dv + p v da$$

This is only a rearrangement of well-known terms, but now comes the crux of the theory, $d(WE)$ need not be zero, says Bailey. This is not startling as long as we talk about a real fluid, for $d(WE)$ merely represents the energy exchange between neighboring stream tubes by shear stress, heat transfer and turbulence. Magnitude of $d(WE)$ is either zero for potential flows, or a generally complicated function allowing for viscosity, heat transfer and momentum transfer. But Bailey is much more concise, he states that $d(WE) = -Pvda$, the transverse energy conversion.

In addition, he claims that two completely different types of flow must be considered: (a) space flow (b) duct flow. In space flow Bailey says that the transverse energy conversion is absorbed or supplied by adjacent flow tubes. Upon this statement his whole theory rests, yet the only justification he offers is: "To say that the imagined molecular boundary of a tube could retain or reflect such transverse expansion energy would deny the very molecular process by which expansion occurs and internal energy changes are brought about."

Now Bailey's flow tubes seem to be the usual conception of such. Yet he ignores the fact that the very basis of a stream tube and its defining streamlines is that, in the absence of turbulence and mixing, *the streamlines could be replaced by a solid wall and the fluid would never know the difference.*

Though eq (9) : $d(mv) + d(pa) = 0$ for space flow has the dimensions of momentum, it is no guarantee that it is a correct interpretation of Newton's second law.

Figure 1

Consider a differential portion of a stream tube, Fig. 1. Neglecting viscous forces:

$$d(mv) = \Sigma\, forces$$
$$= pa + (p + \frac{dp}{2})\,da - (p + dp)\,(a + da)$$
$$= pa + pda + \frac{dpda}{2} - adp - pa - pda - dpda$$

and dropping higher order differentials,

$$d(mv) = -adp$$

compared to Bailey's

$$d(mv) = -d(pa) = -adp - p(da)$$

from which we can see that his subtracting the $pvda$ term was equivalent to assuming that a stream tube wall can impose no forces. This error is again a consequence of not defining the system.

Application to Fluid Flow. Let us examing Bailey's predictions on liquid flow.

Space Flow Into a Duct. From his eq (9), Bailey deduces that maximum possible energy flow from free space occurs when $p/p_o = 1/3$, Fig. 2. He says tests of straight

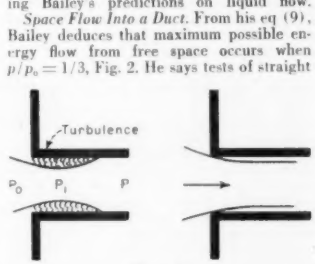


Figure 2

tubes of length/diameter ratio 1.0 to 4.0 show the jet breaks free from the tube at this ratio. He concludes that zero slope on his energy curve causes this phemonenon. For some reason, added proof to him is a high-pitched whistle starting at the same time.

Classical fluid mechanics shows that for a tube flowing full:

$$p_i = p - k(p_o - p)$$
$$\text{or} \quad \frac{p_o}{p} = \frac{p - p_i}{pk} + 1 \qquad (1)$$

where p_i is the pressure at the vena contracta and k (a constant for any one experiment) a function of the flow coefficients that will be discussed in the next section. This equation shows that the *tube flowing full is an unstable type of flow* with an absolute upper limit of $p_o/p = (1/k) + 1$ when $p_i = 0$. (p 288 of Bailey's reference 2 points out special steps are sometimes necessary to make the tube flow full.)

More precisely the fluid breaks free when p_i reaches the vapor pressure of the liquid and thus p_o/p is a function of such diverse factors as the liquid under consideration, the liquid's temperature, amount of dissolved gases, and flow coefficients, which themselves are functions of many things. Moreover, the only effect tube length has is insofar as it permits gravity to cause the jet to droop until it touches the walls.

One wonders just how many variables

THERMODYNAMIC Argument Corner

continued

Bailey changed in his tests. Assuming he used water at ambient with p = atmospheric pressure and using normal flow coefficients, one can find by eq (1) above that $p/p_o \sim 0.46$. According to several sources (2, 3) breaking free in tests usually occurs at $p_o = p = 38$ to 48 ft of water, which gives an average $p/p_o = 34/77 = 0.44$. Looking at Bailey's Fig. 3, he indicates beginning of test instability at about $p/p_o = 0.42$, not 0.33.

Hardest to swallow is the statement that maximum energy flow occurs when the jet springs clear. Place a pelton wheel in front of Bailey's tube and I guarantee the power output will increase with $p_o/p > 3$. Amazingly enough in the compressible fluid nozzles where there is a maximum possible energy flow at the critical pressure ratio, Bailey's theory deduces no ultimate maximum.

Liquid Nozzles. In Bailey's Fig. 5, he uses his space flow equation from 0 to 1 and the normal energy equation from 1 to 2, since this is duct flow. His major conclusions are: (1) While a straight-walled tube becomes unstable at $p_2/p_o = 1/3$, a tube with $a_1/a_2 = \sqrt{2}$ will have no critical pressure ratio. (2) His equation (46) for flow rate and his theory automatically give his equation (47) for evaluating the discharge coefficient C_D.

In the first conclusion it is amazing that Bailey places no emphasis on the slope between a_1 and a_2, but only on their ratio. It is known, however, that with a well-rounded entrance and well-designed nozzle shape one can build a stable nozzle with a wide variety of ratios a_1/a_2. Indeed, a C_D of 0.98 or 0.99 is not uncommon compared to the 0.91 achieved by Bailey.

The second conclusion may be criticized in the same manner, but it is more instructive to examine his test results for C_D on p 78. Bailey admits his caluculated C_D can only be compared with the below critical values. Thus, his closest value is about 9% off. In the case of stable flow it has already been pointed out that proper shaping of the same nozzle would give a C_D of 0.98 to 0.99. Even more significant is the fact that Bailey nowhere has yet made provision for any friction or turbulence losses after entrance into the duct. His transverse energy loss all took place before entrance. Were he to admit such losses in the tube his C_D would have to be lowered even more.

It is not the place of this paper to develop the correct theory of nozzles and orifices (2, 3). In short, C_D is the ratio of the actual rate of discharge to that if there were no friction and no contraction. $C_D = C_v C_c$. C_v, the velocity coefficient is the ratio of the actual average velocity to the ideal velocity if there were no friction. C_c the contraction coefficient is the ratio of the minimum jet area to opening area.

C_v depends mainly on entrance shape, wall roughness and Reynolds number and will vary for a nozzle with the excellence of design and manufacture. The low value, about 0.82, of Bailey's tube flowing full is caused by the turbulence, Fig. 2.

C_c, on the other hand, always equals unity for a well-designed nozzle. Fig. 3, if entrance area is taken as AA. It is also

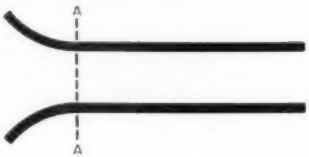


Figure 3

unity in Fig. 1 since the jet fills the tube.

For the perfect fluid case, assuming liquid at rest along the walls, it can easily be shown (2, 3) that for the re-entrant tube, Fig 4, $C_c = 0.5$ (or $0.5/C_v^2$ for a real fluid). This is closely checked in practice where $C_c \sim 0.52$. Thus, unity and one-half set the theoretical limits for C_c.

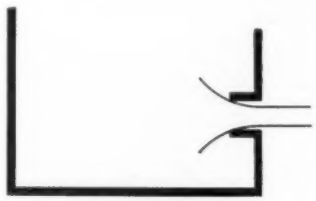


Figure 4

For the sharp-edged orifice (or its equivalent, Fig. 2) C_c varies from 0.72 to 0.61. The larger values occur with small orifices and low heads where capillarity, adhesion and surface tension have noticeable effects. With 2-in. or larger orifices and heads above 5 ft, $C_c = 0.61$ seems the limiting value. Variation from 0.5 is caused by movement of liquid along the walls.

Conclusions. (1) Bailey does not define "space flow" rigorously. For instance, one might ask if flow from a 6-in. pipe into a 1-in. pipe were space flow, or a 60-in. pipe into a 1-in. pipe?

(2) His assumption that "transverse energy cannot be transmitted in space flow" has no foundation other than his own intuition. One wonders what happens to this energy and where it goes.

(3) When applied to liquid flow the theory gives results which are not valid either as theoretical or empirical predictions. A close study of the other proposed applications will most probably bring similar conclusions.

References: (1) Keenan, *Thermodynamics*, Chap 1-4, John Wiley & Sons, 1949. (2) Daugherty, *Hydraulics*, Chap 7, McGraw-Hill Book Co, 1937. (3) Dodge & Thompson, *Fluid Mechanics*, Chapter 11, McGraw-Hill Book Co, 1937.

Here is Neil Bailey's specific answer to comments of Prof Shapiro:

NEIL P BAILEY, *Rensselaer Polytechnic Institute:* In the first place, I have no conceivable quarrel with Newton's laws or with the principle of conservation of energy. I do have an active distrust, extending over many years, of the manner in which these principles have been applied to some specific situations. Since these points rest far back in the history of the subject, they are really things that have been accepted without question for several generations. The references you recommend have all accepted these things without question, so little aid in sorting them out could be expected from there.

First point concerns the amount of energy removed from a space by a fluid leaving it. If the thinking on this subject is traced back through the years, few attempts at justifying the application of Bernoulli's constant-energy-flow equation to it are found. In about 1800, the French hydraulicists were working with orifices and nozzles near the bottom of gravity water tanks. In deducing the velocity with which water should leave, they finally argued that if an isolated object fell through that distance, it would have a velocity corresponding to the work done by gravity.

They then, erroneously, applied the same reasoning to a pound of water. They forgot that while their original object was free to fall independently, the water was part of a continuous medium. In such a continuous medium no part can move independently of the rest. True, in coming from the water surface to the nozzle opening, gravity did do the proper amount of work on the pound of water. The trouble was that even though the pound did flow out, other pounds in the tank that were affected by its motion did not go out with it. Because the pound was part of a continuous medium it did not arrive at the opening with the proper amount of energy.

When calibration tests showed results that did not agree with their assumption, the very practical French engineers started using entrance-loss coefficients to square their theory with their test results. In this way they brought the two together but only in retrospect. Having started out with incorrect theory they could not anticipate new, untested situations.

The last strenuous contesting of this situation was reference 1 (p 76, March 1952, POWER)—a contest given up about 1840. At the hydraulics symposium of the ASCE in 1902 is the last worried remark on the subject I have been able to find. Otherwise, the assumption of constant energy flow from a space apparently has not been looked at during the present century.

My contention concerning the incorrectness of this assumption can be both reasoned and demonstrated. Please reinspect the critical pressure-ratio table and Fig. 3 showing stability curves for liquids and gases. If this phenomenon is due to the boundary layer causes as you contend, how do you explain the prediction of the pressure ratio required to cause this unstable flow transition and the prediction of the tube taper required to suppress it? Experimental work referred to in reference 2 is also worthy of close study.

My second general point concerns the difference between flow in ducts and flow in space. When a moving object comes into elastic contact with a stationary surface, its total energy is in no way affected by the impact. There is only a redirecting and redistributing of the original energy for the force of the stationary wall moves through no distance. The point at stake here is such a basic one that I believe it can be brought out clearly in a rather simple way.

Imagine several men running abreast close together and all at the same forward speed. Suppose they all reach out sideways with their arms and push against each other. If no one of them moves sideways, no work has been done in the transverse direction and no energy is exchanged. Next, imagine a fellow in the center who succeeds in pushing both of his running companions through a sidewise distance. He has yielded up some muscular energy which was received by his companions. On the other hand, a runner who pushes against a stationary guard rail with a side thrust receives no energy from the guard rail and gives up none to it.

So it is with moving flow streams. In ducts with stationary solid walls no sidewise energy is exchanged. But, orderly flow streams in space with moving molecular boundaries do and can exchange energy. A converging stream is receiving energy from surrounding ones and a diverging one gives up energy. There is, of course, a limit to the amount and extent of this energy transfer. Both our own work and that in reference 2 show that artifically generated turbulence in the space from which a liquid flows does modify the results somewhat, but does not eliminate this action.

Material that will be in the forthcoming book shows that in a large inlet such as the entering duct of a jet engine, this space type flow occurs predominantly near the entering edges of the duct walls. The only place where the entire flow is of this type appears to be flow from a near stationary supply into a pipe or nozzle.

The accuracy, with which the unstable range between the peak of the "pressure function" curve and the peak of the "area function" curve of Fig. 8 predicts the occurrence of "compressibility bubbles," cannot be lightly dismissed. These make their appearance as air attempts to come around a curving surface, either with or without time for boundary layer to build up with regularity, not at the acoustic velocity but at a local velocity ratio of 0.707. There is little doubt in my mind that this unstable space flow region will go far in the promotion of a clearer understanding of "transonic" phenomena.

In your discussion of my eq (15) (16) and (17) you wrote a second equation for constant-weight flow at all points. My Figs. 1*b* and 2, together with the discussion, make it clear that this was not even under discussion. Consequently, any conclusions you reached from your own equation can hardly have an application to a case where it was definitely stated that weight flow was not constant.

Finally, as to "stagnation" or, as I prefer, "impact" temperature, you and I both know that for years we have said, *total temperature remains constant.* Always, when doing careful test work, we have observed that measuring instruments do not agree with us. Being thoroughly convinced of the original assumption, we proceed to alibi for the thermocouple. This has gone on, until at the present time a perfectly startling structure of arguments has been erected around this point.

When one frees himself from years of such servitude and asks just what part of energy of a flowing gas stream affects a thermocouple, the results are little short of astounding. It is a great satisfaction to see the complications disappear and to see theory doing a far better job of anticipating what the thermocouple will say.

As a general answer to criticisms of his original article, Prof Bailey releases the following portions of his forthcoming book:

Forces in Gases. A single steady force can be applied only to an aggregation of material that is bonded together. To exist as a steady force it must remain in continuous contact with the material. How can a single steady force hold myriads of molecules in equilibrium? The molecules not only are unbonded, they are not even in continuous contact. They are never all in contact at once.

A specific answer to this question is required before the validity of conventional flow-tube force diagrams using pressures as forecast can possibly be accepted.

The pressure P used in *thermodynamics* for the purpose of defining the state of a gas, has no meaning in *mechanics* except as an averaged value of molecular impact forces on a solid surface. Only in terms of the *thermodynamic* use of pressure as a definition of state can the motion of free molecules in space be studied. Its use in the space flow of molecules in the *mechanics* sense of a force, when no solid surface exists, is invalid and completely unacceptable.

Energy Conversion. Since the fluids used in thermodynamic processes are molecular in nature, all energy conversions depend ultimately on molecular processes. Molecules can experience impacts with stationary surfaces, with moving surfaces, and with each other.

An elastic impact of a molecule with a thermally neutral stationary surface does not change the translational kinetic energy of the molecule. It redirects its velocity and is a very useful device for redirecting streams of molecules without altering their energy. A molecular impact, with such a surface moving in the direction of the molecule that strikes it, not only changes the direction of motion of the molecule but also receives energy from the molecule. Thus, work is done by a gas on a moving engine piston.

When elastic impacts occur between gas molecules, energy is transferred from the faster moving one to the slower one. In this manner, energy can travel through gas molecules. But there is no momentum change in any direction as a result of such molecular impacts with other molecules. An elastic impact of a molecule with an imagined frictionless and thermally neutral surface can change molecular momentum only in a direction normal to the surface. No momentum change parallel to such a surface can result. The momentum change of the molecules normal to the surface exerts a force that must be resisted by the surface.

In the energy-flow equation:

$$WE = Wu + W(v^2/2g) + Pav \quad (1)$$

there are three ways of changing the internal energy u of a pound of gas with a specific volume V at a pressure P. Heat may be added to it from an external source, kinetic energy may degenerate to internal energy through turbulence, or a volume increase dV done against a surrounding pressure P may transfer out an amount of internal energy given by

$$du = -PdV \quad (2)$$

For a nonturbulent process with no heat transfer the elastic change $-PdV$ is the only remaining mechanism for changing internal energy u.

When the same weight flow of gas W flows at all points along a path, the weight flow W, the specific volume V, the velocity v and the necessary flow area a are related by the steady flow equation

$$WV = av \quad (3)$$

If this steady-flow equation is combined with the energy-flow equation, one result is

$$WE = Wu + (Wv^2/2g) + WPV \quad (4)$$

$$E = u + (v^2/2g) + PV \quad (5)$$

Differentiating eq (5) will reveal the requirements for constant-energy flow with varying velocity and flow area.

$$dE = du + (vdv/g) + PdV + VdP \quad (6)$$

If this is further restricted by calling for a nonturbulent change with no heating, eq (2) can be used to give

$$dE = -PdV + (vdv/g) + PdV + VdP \quad (7)$$

Using eq (3) in eq (7) to eliminate V

$$dE = (vdv/g) + (av/W)dP \quad (8)$$

The requirement for constant energy $dE = 0$ flow is then, that

$$\frac{v}{W}\left(\frac{Wdv}{g} + adP\right) = 0 \quad (9)$$

$$(Wdv/g) + adP = 0 \quad (10)$$

This is the significant flow solution for the condition of constant-energy flow.

The momentum per second M of this flow at any point is

$$M = Pa + (W/g)v \quad (11)$$

Differentiating this

$$dM = Pda + adP + (W/g)dv \quad (12)$$

$$(W/g)dv + adP = dM - Pda \quad (13)$$

A comparison of Eq (10) and (13) makes it clear that constant-energy nonturbulent flow can occur only if

$$(W/g)dv + adP = 0 = dM - Pda \quad (14)$$

$$dM = +Pda \quad (15)$$

This says simply that constant-energy, nonturbulent, accelerated or decelerated flow can occur only when a momentum change $dM = +Pda$ accompanies it. Since momentum changes do not result from molecule to molecule impacts, impacts of molecules against solid surfaces must be present.

The importance of solid guiding surfaces in the flow of fluids thus becomes evident. Only through the forces exerted by surfaces or walls with little friction can nonturbulent constant-energy flow be approached during acceleration and deceleration.

The next point of interest is to express the amount of energy that must be transferred from the flow if constant momentum, nonturbulent flow is to occur. This can be implied by putting the momentum change dM of eq (12) to zero, giving

$$Pda + adP + (W/g)dv = 0 \quad (16)$$

multiplying by v

$$Pvda + avdP + (W/g)vdv = 0 \quad (17)$$

This gives

$$(W/g)vdv = -vd(Pa) \quad (18)$$

From eq (1) for steady flow W

$$WdE = Wdu + (W/g)vdv + d(Pav) \quad (19)$$

Combining eq (18) and (19)

$$WdE = Wdu - vd(Pa) + d(Pav) \quad (20)$$

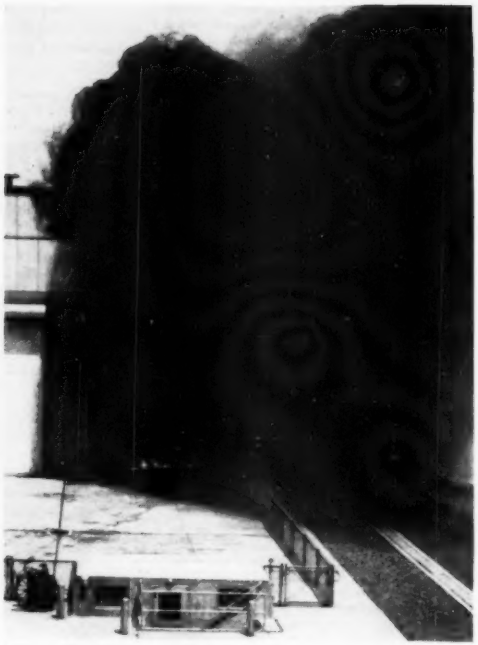
This gives

$$WdE = Wdu - vd(Pa) + vd(Pa) + Padv \quad (21)$$

$$dE = du + (Padv/W) \quad (22)$$

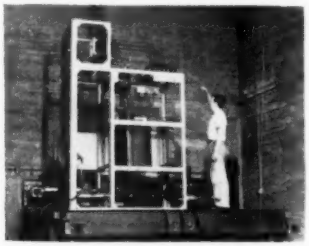
(*Continued on page 208*)

SPLIT SECOND after test breaker opened short-circuit current above its rating, flames flooded test cell in new GE lab



HIGH PRESSURES developed in breaker ruptured phase-tanks, belched out the burning oil. Extinguishers are now in action

This Is What Happened When This Low IC Circuit Breaker → Opened a High-Current Short



► YOU CAN'T TALK switchgear nowadays without brushing with the term *interrupting capacity*. Linked with a circuit breaker, it means how much kva the breaker can successfully interrupt. If the breaker's ic is way below the kva that can be supplied, and she's called on to open a heavy short, your breaker may explode into a blazing mass of burning oil and molten metal. Skeptical? Well let's probe a little behind the photos shown above.

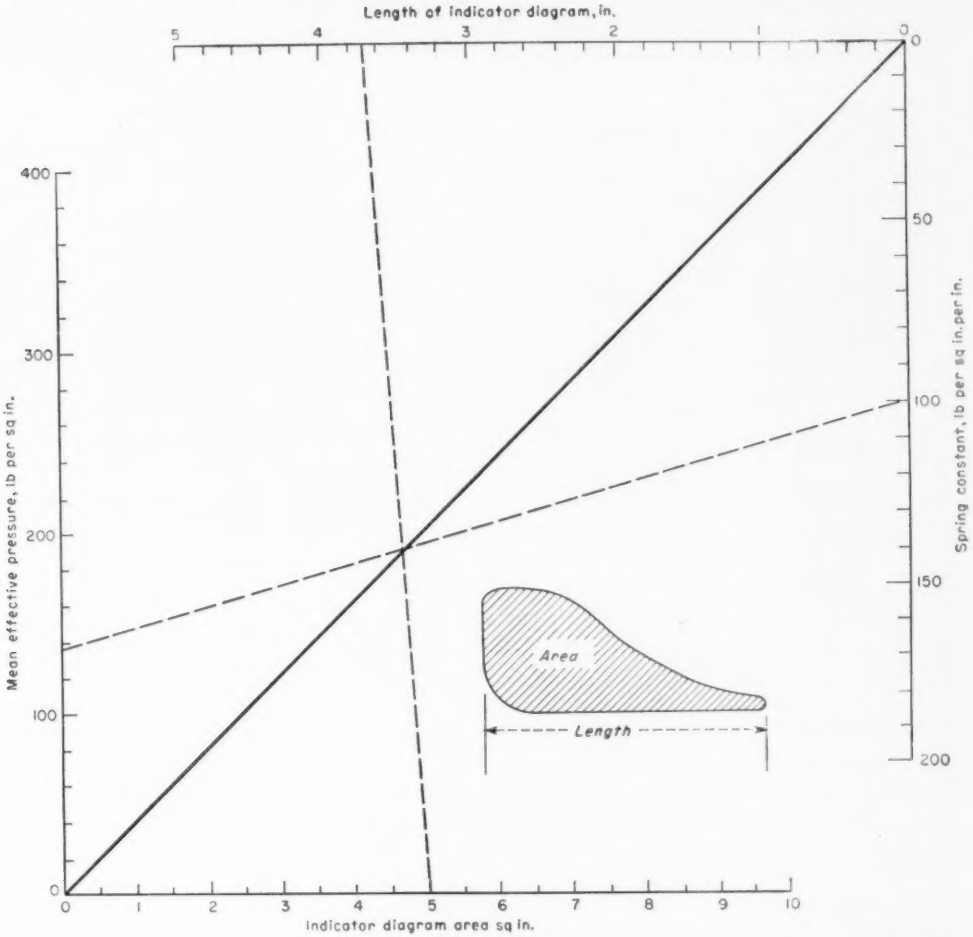
Lab Test. Before going through its final paces at GE's new switchgear development lab, this breaker was typical of a unit bought back in the early twenties. It had plenty of ic for its original duty. Rated 15 kv, 600 amp and with an ic of 90,000 kva, it would still handle its rated ic without any fuss. But now instead of 90,000 the local utility can deliver 250,000 kva; a reasonable assumption.

These were the test conditions. The short circuit was handled by putting a grounding strap across all three phases on the load side of the breaker. Then the power was thrown on and the breaker tripped. Photos tell the rest.

System Capacity. One reason for the low ic of yesteryear's breakers was their slow tripping. Years back, a breaker was allowed 30 cycles (half sec) to clear a fault. Now this time element is cut to 3 cycles in the modern breakers.

Don't look at load current alone when selecting a plant circuit breaker. For adequate protection, size of the power system feeding the plant must be reckoned with. Your possible short-circuit current is directly related to power source capacity. Big systems can supply big short-circuit currents.

Take a case in the low-voltage field. A 440-v 3-phase 10-hp motor draws about 13 amp at full load. And it will draw only this amount of current whether supplied by a 25-kva or a 2500-kva transformer bank. So if you are to consider only the load currents when selecting a breaker, a 15- or 20-amp unit would do the trick. But size of the power system feeding the motor plays the leading role in this picture. You need a circuit breaker with larger ic to handle the possible short-circuit current from 2500-kva than from 25-kva unit.



Finding Mean Effective Pressure

► INDICATOR DIAGRAMS are used for checking valve operation in steam engines, compressors and internal-combustion engines. In testing performance of these machines, however, they are used to measure the amount of mechanical work developed or absorbed in the cylinder. This is found as the mean effective pressure (mep) in lb per sq in. (psi), and equals the average height of the indicator diagram, figured as:

mep = diagram area × spring constant ÷ diagram length

where diagram area is in sq in. measured by a planimeter, spring constant of indicator is psi per in., diagram length is in in. The nomogram solves this equation quickly.

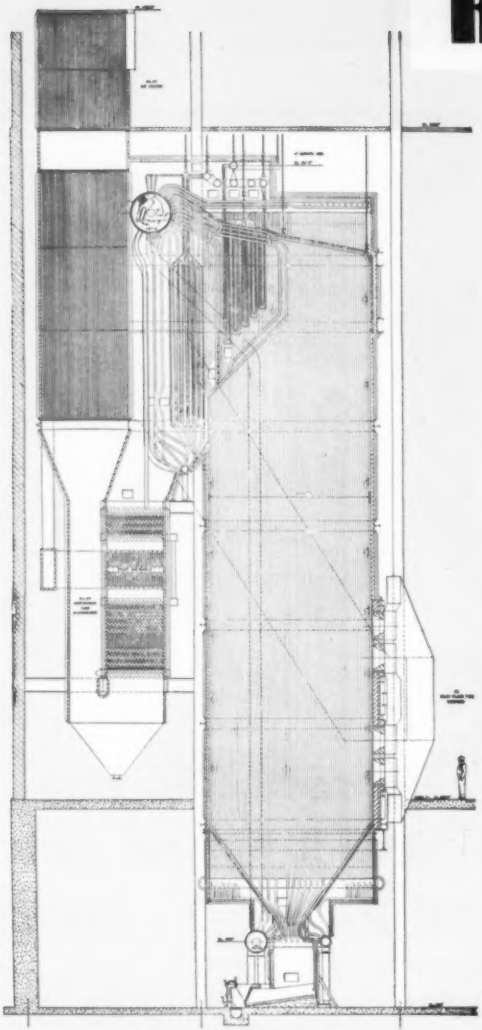
Example: Spring constant of the indicator is 100 psi per in., the diagram area measured by planimeter is 5.0 sq in., diagram length is 3.7 in. Find the mep.

Draw a line from 5.0 on lower scale (diagram area) to 3.7 on upper scale (diagram length). From intersection with diagonal draw a straight line connecting with 100 on right-hand scale (spring constant) and extending to intersect left-hand scale. Here read the answer as a mep of 135 psi.

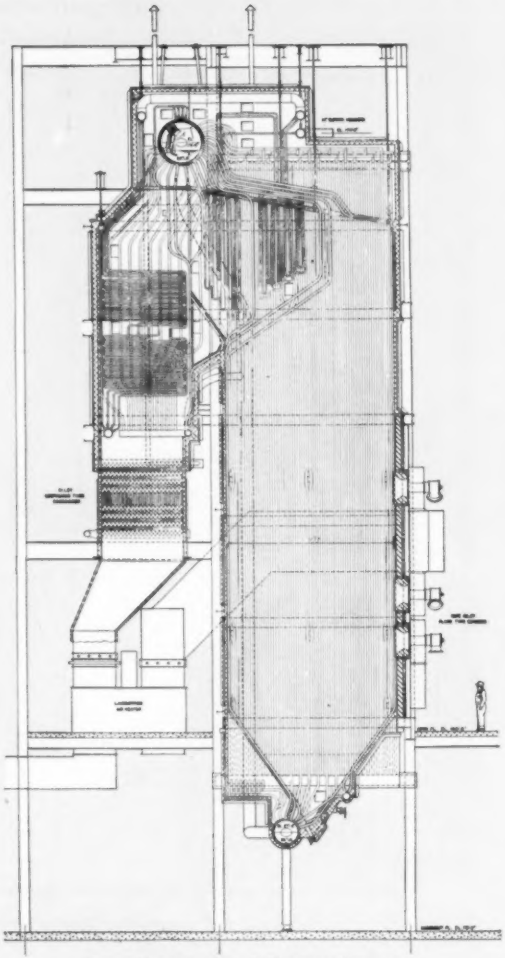
R F CLOTHIER *Auburn, Alabama*

© POWER

Recent RILEY



CENTRAL ILLINOIS LIGHT COMPANY
R. S. Wallace Station, Peoria, Illinois
600,000 lbs./hr. 950 psig 900°F.
This is the fifth Riley unit at this station.



SOUTH CAROLINA GAS & ELECTRIC COMPANY
Plant Hagood, Charleston, South Carolina
400,000 lbs./hr. 1475 psig 955°F.
This is the third Riley unit at this plant.

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

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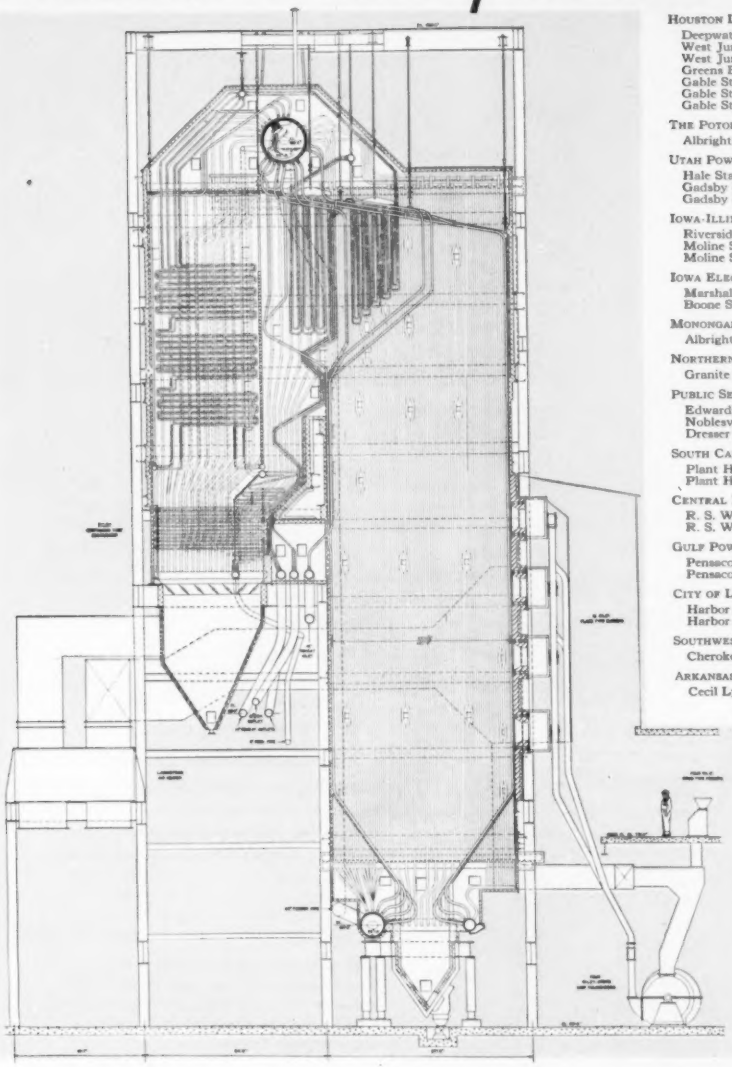
Public Utility Installations



HOUSTON LIGHTING & POWER COMPANY		
Deepwater Station	1—	1,300,000 lbs./hr.
West Junction Station	2—	825,000 lbs./hr.
West Junction Station	2—	400,000 lbs./hr.
Greens Bayou Station	2—	675,000 lbs./hr.
Gable Street Station	1—	350,000 lbs./hr.
Gable Street Station	1—	250,000 lbs./hr.
Gable Street Station	1—	140,000 lbs./hr.
THE POTOMAC EDISON COMPANY		
Albright Station	1—	700,000 lbs./hr.
UTAH POWER & LIGHT COMPANY		
Hale Station	1—	450,000 lbs./hr.
Gadsby Station	1—	620,000 lbs./hr.
Gadsby Station	1—	575,000 lbs./hr.
IOWA-ILLINOIS GAS & ELECTRIC COMPANY		
Riverside Station	3—	250,000 lbs./hr.
Moline Station	1—	250,000 lbs./hr.
Moline Station	2—	200,000 lbs./hr.
IOWA ELECTRIC LIGHT & POWER COMPANY		
Marshalltown Station	2—	300,000 lbs./hr.
Boone Station	1—	275,000 lbs./hr.
MONONGAHELA POWER COMPANY		
Albright Station	1—	700,000 lbs./hr.
NORTHERN STATES POWER COMPANY		
Granite Falls Station	1—	385,000 lbs./hr.
PUBLIC SERVICE COMPANY OF INDIANA		
Edwardsport Station	3—	400,000 lbs./hr.
Noblesville Station	3—	300,000 lbs./hr.
Dresser Station	1—	300,000 lbs./hr.
SOUTH CAROLINA GAS & ELECTRIC COMPANY		
Plant Hagood	1—	400,000 lbs./hr.
Plant Hagood	3—	230,000 lbs./hr.
CENTRAL ILLINOIS LIGHT COMPANY		
R. S. Wallace Station	1—	600,000 lbs./hr.
R. S. Wallace Station	4—	300,000 lbs./hr.
GULF POWER COMPANY		
Pensacola Station	1—	325,000 lbs./hr.
Pensacola Station	2—	230,000 lbs./hr.
CITY OF LOS ANGELES		
Harbor Steam Station	3—	825,000 lbs./hr.
Harbor Steam Station	2—	675,000 lbs./hr.
SOUTHWESTERN GAS & ELECTRIC COMPANY		
Cherokee—Texas	1—	630,000 lbs./hr.
ARKANSAS POWER & LIGHT COMPANY		
Cecil Lynch Station	1—	650,000 lbs./hr.

UTAH POWER & LIGHT COMPANY
Gadsby Station
Salt Lake City, Utah
575,000 lbs./hr. 1700 psig
1000°F. Reheat 1000°F.

This is the second Riley unit at this station. Utah Power & Light Co. have ordered five Riley units.

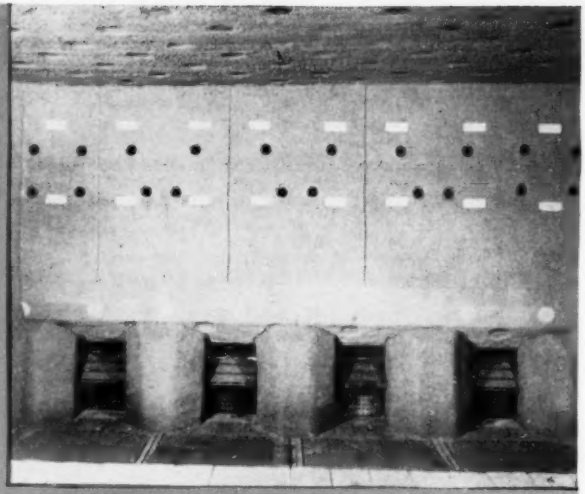
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

SPECIFY
A. P. GREEN
Plastic Firebrick Linings
FOR LONGER LIFE... LOWER MAINTENANCE COSTS



View of monolithic SUPER-PLASTIC front wall showing stoker openings, stoker piers, and ignition arch.

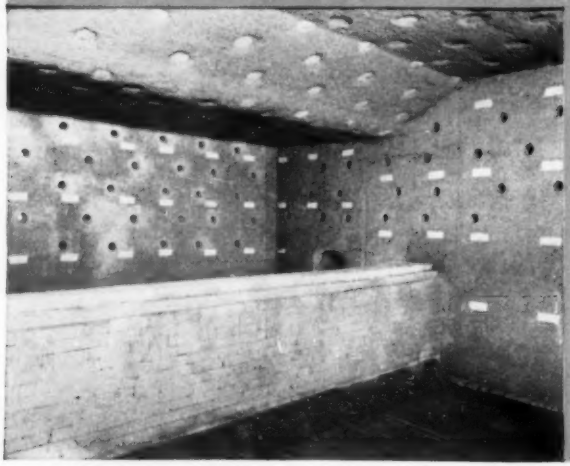
For over 30 years, A. P. Green plastic firebrick, made from highest quality Missouri fire clays, has been proved in service. Three grades of plastic to meet varying refractory needs.

These photos show an air-cooled setting installed in a large coal drier furnace with A. P. Green plastic firebrick. The entire firebox section—walls and flat suspended arch—was lined with A. P. Green SUPER-PLASTIC to withstand the high temperatures, severe slagging, and spalling conditions encountered in this area.

A properly engineered A. P. Green monolithic furnace lining is quickly and easily installed. There are no exposed joints open to attack by flame or slag... an airtight lining gives longer furnace life.

In A. P. Green monolithic construction, expansion and contraction are provided for by use of "floating" anchors. These anchors permit free wall movement, horizontally and vertically, yet provide positive anchorage to outer wall.

Looking toward bridge wall. Note the dropnose arch built with SUPER-PLASTIC suspended construction without the use of special shapes.



WAREHOUSE STOCKS FOR PROMPT DELIVERY

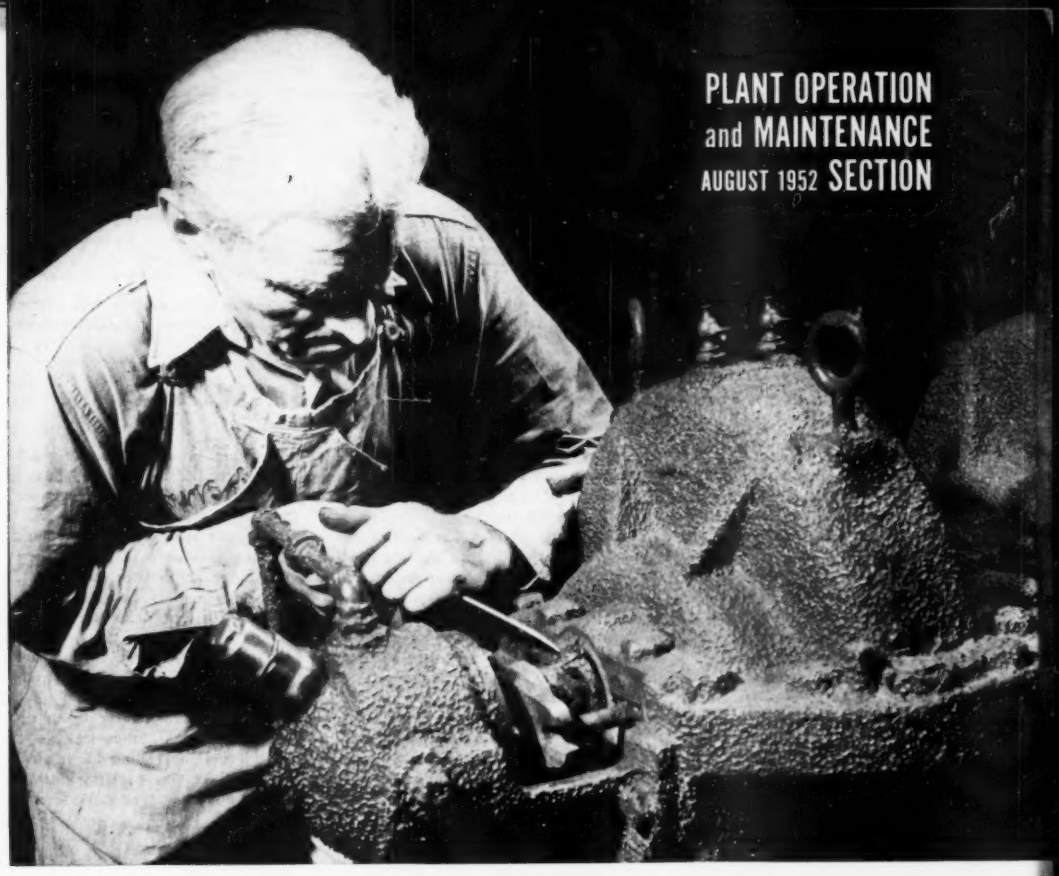
Look in the classified section of the telephone directory or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

A. P. Green
REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK CO.
Mexico, Missouri, U. S. A.

In Canada
A. P. GREEN FIRE BRICK CO., LTD.
Toronto 15, Ontario

Distributors in the Principal Cities of the World



REMOVING OLD PACKING . . .

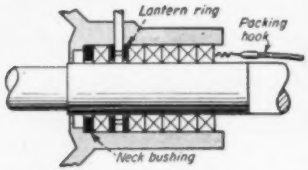
. . . from large centrifugal fire pump is a routine job for Bill Mason, McGraw-Hill maintenance man. But before gland nuts are loosened, electric switch to pump is opened, discharge valve on pump (left open for instant starting) is closed.

Then sign CLOSED is hung on discharge valve. So if Bill is called away before he buttons up pump, he won't come back to flooded machinery room or to burned-out switchboards, squirted from open stuffing box.

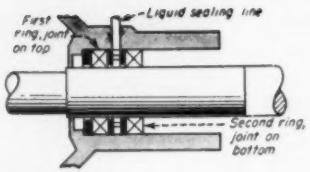
You say everyone knows about these precautions? Sure, they do, but just the same, damage piles up yearly because those simple safety measures are not taken. (Pump in the photo is coated with granulated cork mixed into the paint. That prevents sweating.)

Pack That Stuffing Box

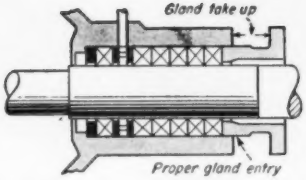
When you say, "The stuffing boxes on No. 3 centrifugal feed pump need packing," or when you give some other packing job to your men, do they know what to do? What tools to use? What safety measures to take before loosening gland nuts? Let Frank Cowan, chief engineer of Arnold Bros., give you handy pointers



REMOVE old packing with hook but be careful not to burr the shaft with hook



STAGGER packing joints from top to bottom. Lantern ring must be in right spot



GLAND must enter stuffing box square and be taken up evenly as packing wears

Taking Out Old—Putting In New

Step-by-step procedure in packing stuffing boxes is about same for either reciprocating or rotary shafts. But you must know the exact style and type of packing for job. Water, steam, oil, acids, caustics or volatiles will affect packing in various ways. So one "common" type won't do for all.

If packing gland is screwed up tight, leaks badly before shutting down equipment, job is long overdue. That's hard on shaft.

Taking out. If gland is split type, remove nuts and place halves together so they go back same way. Even if parts are interchangeable, it's best to put back same way.

With right packing hook, even glazed and brittle packing comes out. If stuffing box has lantern ring, remove it also. Some lantern rings have holes tapped in side for screwing in threaded hook for removal.

Small lantern rings usually have holes for hooking wire to remove them. Withdraw all old packing up to neck bushing. Then make sure gland is clean and shaft is not badly worn.

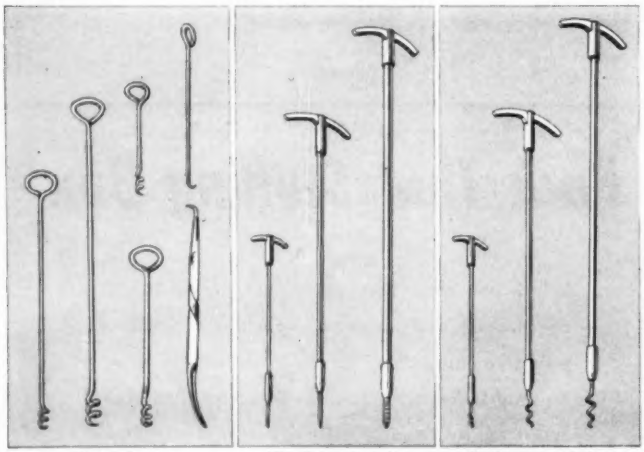
Putting in. What size packing to use? Measure shaft diameter and stuffing-box diameter. If shaft is 1½ in. and box 2½ in., right size packing is one half the difference, or ½ in.

Wrap spiral-type packing snugly around shaft and mark with sharp knife for right length so ends just butt. Then place packing on board and cut either butt or angle joint.

In sketches above, one turn of packing is between lantern ring and neck bushing, with joint on top. Make sure lantern ring lines up with supply pipe for sealing.

Stagger joint of second ring against lantern with joint on bottom. Idea is to have each joint as far as possible from each other, which means at 180 degrees.

Gland must enter stuffing box square and be taken up square. Don't pull up on packing too tight. Slight leakage at gland keeps it lubricated and cool, depending on service. If shaft runs at reduced speeds on new packing until it "runs in," that lengthens life and seals better besides.



Rigid hooks | Wood-screw ends | Cork-screw ends

Handy Packing Hook Sets

Good investment is packing-hook sets shown. Even if you don't have too much use for them, one tough job will easily pay for the right set.

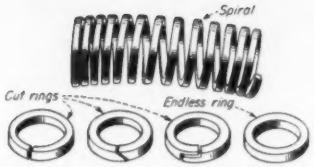
Rigid hooks work well on jobs that are easy to get to, and where you need a good "purchase" or bite into the packing. Flexible-shaft wood-screw ends and cork-screw ends work where packing is solid or where you have to bend hook a little.

Using right hook often depends on trying each type on a tough job and working with hook that is most helpful. For water and steam, it often pays to loosen gland far as it will go and then turn on pressure. Old packing blows out against gland.

CAUTION. New packing is often completely ruined by careless mechanics. It's easy to scratch, burr or nick shaft while packing the box. That also happens when packing valve shafts.

A tiny raised surface on shaft will cut packing as soon as shaft moves. On rotating or reciprocating shaft, new packing is cut so fast it needs tightening often, until raised surface wears off—if it does wear off. Always check shaft under packing for flaws.

Packing and Joint Types



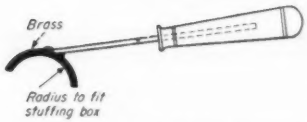
PACKING comes in spiral for cutting to shapes shown, or they come cut to size

Packing job would be simple if endless rings could be slipped over shaft. But most equipment takes cut-rings of one kind or another. One of three joints shown are usually cut from spiral packing, or they come cut to size.

Angle joint is probably used more than butt joint. Step joint is common for plunger or piston, but not necessary where more than one turn of packing is in stuffing box.

Where most packing used is of same size and length, use small board as a miter box. With a stop at one end, packing can be cut either with butt joint or angle joint, without measuring around shaft. Lubricate packing rings if manufacturer suggests it. This is important.

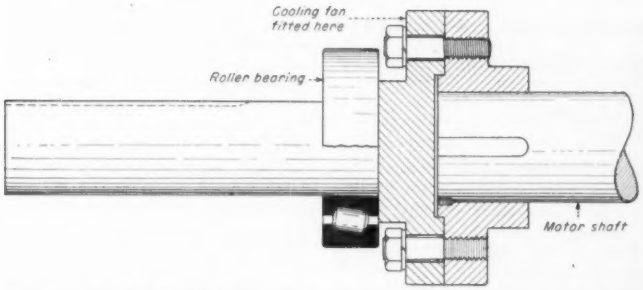
"Squaring Tool" For Packing



TOOL is easy to make. It helps to position each turn of the packing in the box

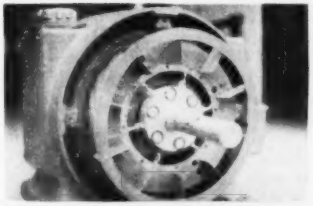
Simple tool to push packing square into a stuffing box is shown. It's made from half-round brass, sized so it enters stuffing box easily. Weld a small rod at right angles for a handle. As packing is pushed into the box, turn tool around to varous positions. Sliding tool against packing squares all rings so they are 90 degrees to the shaft. Repeat on next packing turn to square it also.

This may seem like a lot of trouble, but packing often gets jammed or cocked inside a long stuffing box. Tightening the gland over a fully packed box only squeezes several turns out of shape. Then packing in jammed side of box is tight, while other side has loose packing that more tightening won't cure. I always insist on this tool being used on every important job.

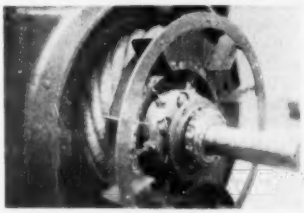


REPAIRED shaft is flanged stub-shaft, bolted to coupling placed on original shaft

COUPLING attached to broken shaft end



NEW shaft end with attached coupling



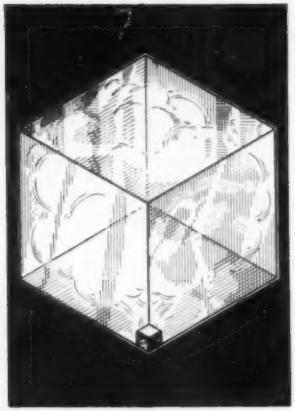
BEARING on shaft and fan on coupling

Repairing Broken Shaft

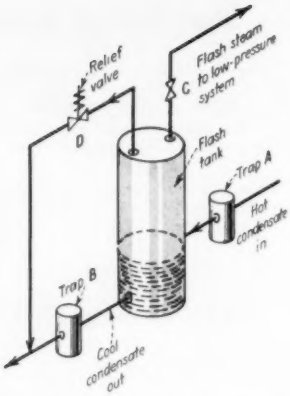
We had a tough emergency repair recently, but managed to do a first-class job. The motor shaft of our 30-hp 1450-rpm 400/440-volt 3-phase 50-cycle slip-ring induction motor broke into two pieces. This motor drives a line shaft and must be kept running. Break was very close to the bearing, inside the motor on the pulley side and was at point shown by couplings in sketch.

We repaired broken shaft with rotor in place. First, we faced off broken end, then milled a keyway for a coupling. Coupling half was also screw-held from end. Next, we machined a large piece of stock into a stub-shaft, with a coupling at one end. After bolting coupling halves together, we pressed on roller bearing. Then fan was attached to the new coupling inside motor, instead of to shaft as before. If break had been anywhere but in center of fan's position, coupling could not have been used. A new shaft would have been only solution—and we did not have one. This repair has held up as good as a new shaft to date.

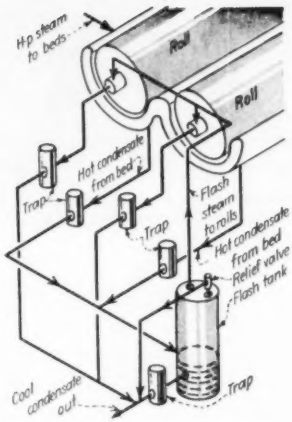
C A Abraham *Madras, India*



1 Flash steam from 100-psi condensate takes up 1600 times as much space



2 Typical flash-tank hookup you can use for making steam in industrial plant



3 Laundry ironer uses 9% less steam when hooked up for 1-p flash system

Don't Waste Flash Steam—It Can

If you have much high-pressure condensate in your plant you should think about using it to make flash steam. A good flash system saves heat, cuts fuel costs, improves plant efficiency

By **TYLER HICKS**, *Associate Editor*

► YOU HAVE OR CAN GET flash steam in your plant if you trap heat-producing units or blowdown boilers continuously. Using flash steam may save you money. But to use flash right you must have a few facts on hand. Here they are:

Why Flash? Condensate from steam condensing in a heater or pipe has same temperature as the steam. Temperature of condensate may drop a few degrees if heat is lost to atmosphere, but difference between that and steam won't be much.

Condensate from 100-psig steam has a temperature of 338 F and contains more heat than condensate at lower pressures. If condensate is drained by a steam trap discharging to a return header at a pressure less than 100 psig, you'll get flashing.

Fig. 1 shows how a small amount of condensate at 100 psig "explodes" into steam with a volume 1600 times as great as the condensate. This volume increase occurs when condensate passes into a pipe or tank at atmospheric pressure. Excess heat in the condensate causes flashing at pipe or tank pressure.

Condensate at 100 psig has 309 Btu per lb. At atmospheric pressure, 0 psig, condensate has 180 Btu per lb. So if we discharge our condensate to a vented hotwell the excess heat, 309–180=129 Btu per lb, which is released by the pressure drop, causes some condensate to boil. Steam formed by this boiling is called flash because it forms very rapidly.

Flash Steam. Now let's see what flash steam is. Steam formed in a flash tank, Fig. 2, is the same as saturated steam generated in a boiler at the same pressure. Flash steam can be used in low-pressure units just the way boiler steam is. So when you waste flash you lose money, just as you do when live boiler steam goes to waste.

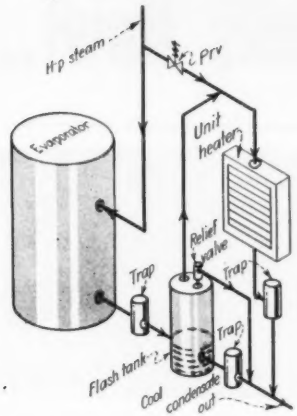
But, and this is a big *but* in some plants, it costs money to collect flash steam. If you have only a few pounds per hour to collect, chances are you'll have to wait several years to pay off collecting equipment and pipe. Fig. 6 shows how much condensate flashes to steam when discharged to a vessel or pipe at atmospheric pressure. Thus 1000 lb of 100-psi condensate discharged at atmospheric pressure flashes to $1000 \times 0.133 = 133$ lb of steam.

Collection. Fig. 2 shows equipment you need to collect flash steam. Hot condensate from high-pressure system flows through trap *A* into tank. Pressure in tank may be atmospheric, below or above atmospheric, depending on system. But tank pressure is always less than that of hot condensate.

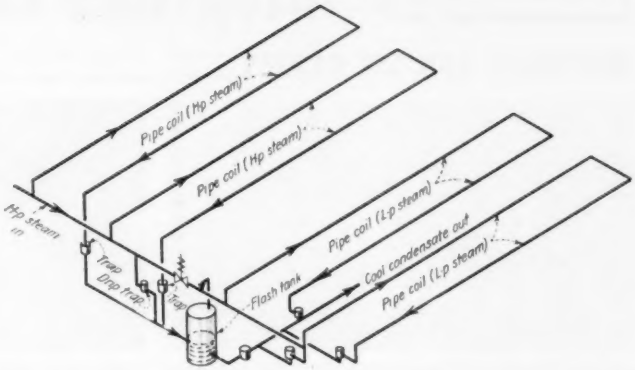
When condensate enters tank, part flashes to steam and leaves through valve *C* to go to the low-pressure system. Cool condensate leaves through trap *B* to go to the hotwell. When steam isn't needed by low-pressure system, relief valve *D* opens and allows flash steam to flow with condensate to hotwell.

Tank Size. There are rules for figuring flash-tank size but you shouldn't try to pick a tank without help of a consulting engineer. Not only is size important but method of construction also needs study. Flash tanks are unfired pressure vessels and should be built to ASME code specifications.

Does Flash Pay? There's only one way to find out. Sit down and figure how much steam you can get with a flash tank. Multiply this by cost of making the same amount of steam at the same pressure in a boiler. Then figure cost of flash tank, extra piping and traps, if



4 Unit heaters can run on flash steam if supply is steady and large enough



5 Save steam in h-p process or building heating systems by flashing h-p condensate in tank, feeding to l-p coils. The l-p coil length may have to be increased

Save Money and Fuel in Your Plant

needed. Savings from using flash steam should pay off equipment cost in a reasonable time.

You may need help with a study like this. If so, call in a consulting engineer. He'll give good advice on what's best for your plant.

Hookups. We learned earlier that flash steam is the same as saturated steam from a boiler running at the same pressure. So that means you can use flash steam wherever boiler steam at the same pressure is used.

Fig. 3 shows a laundry ironer fitted with a flash tank. The beds need 100-psi steam, the rolls 15 psi. High-pressure condensate from the beds is trapped and discharged to the flash tank. Here it flashes to 15-psi steam and flows to the rolls.

With a constant supply of steam to the beds there will be a continuous flow of 15-psi steam to the rolls. About 10% of the high-pressure condensate flashes to steam. Flash tank allows you to save about 9% of the total amount of steam the ironer needs. Equipment cost is low; all you need is a small flash tank, an extra steam trap, some pipe and a relief valve. Insulate tank and all piping for best results.

Unit Heaters. Fig. 4 shows a low-pressure unit heater that is fed steam from a flash tank. High-pressure condensate from an evaporator or other steam-using unit flashes in tank and passes to unit heater. Of course, enough condensate must flow to flash tank to produce steam needed in heater. Excess steam passes through relief valve to condensate line running to hotwell.

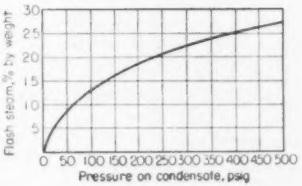
Pipe Coils. For either process or building heating, these units can often be hooked up to save steam if they run at high pressure. Fig. 5 shows a typical system whose first two coils use high-pressure steam, the last two flash steam.

Condensate from high-pressure coils and supply main passes to flash tank where part changes to steam. This steam enters low-pressure main to supply other pipe coils. To produce the same amount of heat in both high- and low-pressure coils you will find that latter must be made larger if pressure-regulating valve doesn't feed to low-pressure main. For best economy, try to run system without feeding steam directly from high- to low-pressure main.

Other Jobs. By careful study of your process-steam plant you can find many other jobs for flash steam. Paper and textile mills, laundries and process plants of many types make good use of flash steam. But before building a system don't forget that:

1. Only part of your high-pressure condensate flashes to steam. So check condensate flow to see that enough steam will be produced.

2. Condensate flow must be continuous for good results. Frequent starting and stopping introduce running problems.



6 Percentage of flash steam formed if condensate is discharged to open air

3. Check to see flash system pays out. In small plants or large ones with low condensate flows you may not be able to justify extra equipment.

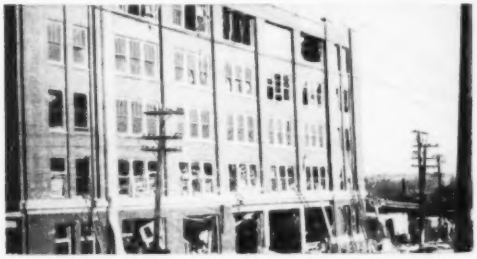
4. This article has stressed industrial uses of flash steam. Continuous blowdown systems produce flash in a similar way. Remember that some states and cities may require that you reduce blowdown temperature before discharging to sewer. Flash steam obtained this way shouldn't be wasted.

5. Lastly, for any flash system, use this rule of thumb: For each 10 F of condensate temperature above 212 F, about 1% of the condensate flashes to steam when the condensate flows to a vessel at atmospheric pressure.

OPERATORS' NOTEBOOK 55

Stop Gas Leaks Now...

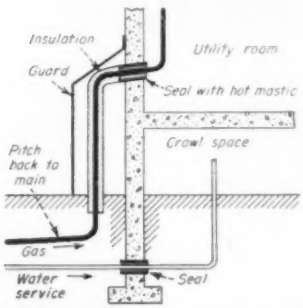
WRECKAGE AND ITS CAUSES



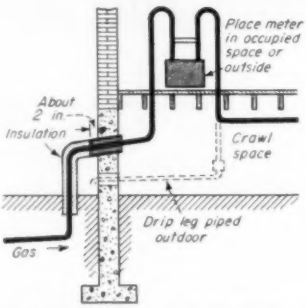
SERIOUS ACCIDENTS like this mount yearly as gas leaking into basement from the high-pressure main explodes. Cost to industry runs into millions now that gas is being widely used

FURNACE EXPLODES under all types of boilers when gas leaking into gas-fired boiler is not purged. Accumulated gas from leaking burner was ignited by hot shutdown furnace here

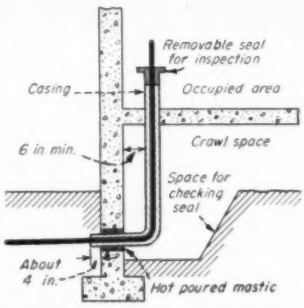
PREVENT WITH RIGHT PIPING



BYPASS gas around crawl space from outside so leaking gas won't follow the piping inside. Insulate against freezing

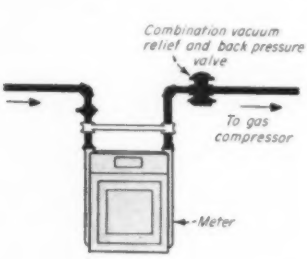


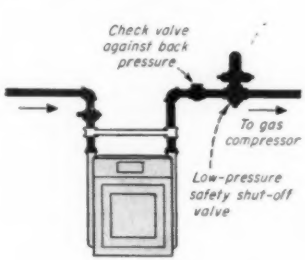
IF YOU MUST run long piping under crawl space, do as shown. Put meter in occupied space or in vented building



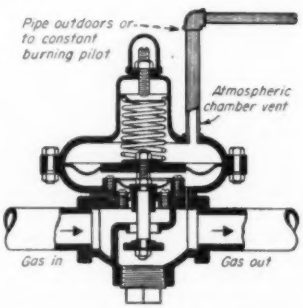
CASING around gas line coming up from crawl should have removable seal for inspection. Make space for checking

SAFEGUARD METER . . .





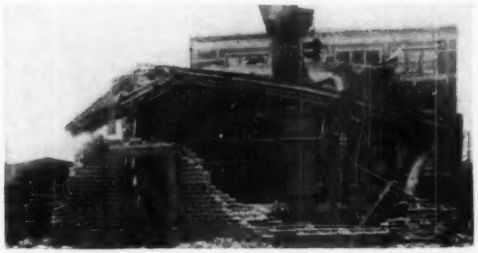
PLACE vacuum relief valve between gas compressor, or booster pump, and meter if meter is for less than 5 psig, *left*. Check-valve guards against backpressure where air or oxygen exceeds gas pressure or where the gas from the h-p system may back up



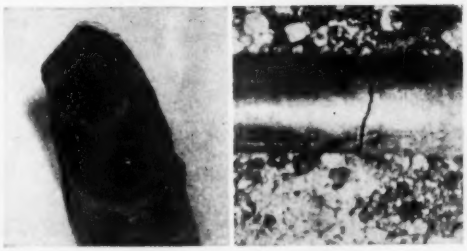
PIPE atmospheric chamber of pressure regulator to outdoors or to a constant burning pilot. *Never leave vent unpiped*

...From Wrecking Your Plant

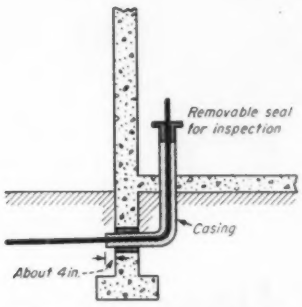
By **STEVE ELONKA**, *Associate Editor*



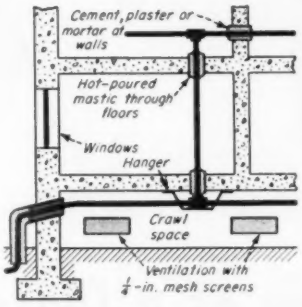
SMALL ARC from switch wrecked this compressor house when operator flipped on light switch. Slow-leaking gas valves let in enough gas to damage many plants like this one yearly



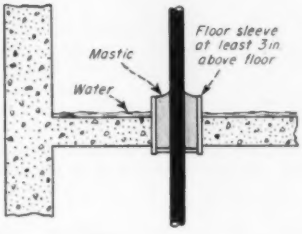
CORRODED PIPE *(above)* at ground level is main hazard. Gas leaks into unused part of building. Cracked main *(right)* under building lets in gas, often is ignited by a pilot light



BURIED piping coming up through floor must be encased, sealed with removable seal at one end. Other end is as shown

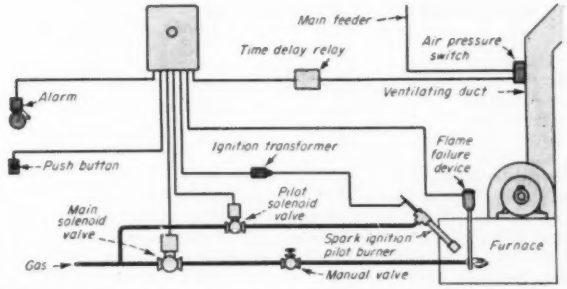


VENTILATE crawl spaces or unused spaces if piped for gas. Seal walls, floors around piping to localize escaped gas



WET FLOORS corrode piping. Use floor sleeve high enough above floor to keep water from line. Paint all gas piping

. . . AND FURNACE



GAS-BURNING furnace needs this hookup for purging. Air-pressure switch in ventilating duct prevents ignition of accumulated gas before furnace is properly purged before relighting. Flame failure device shuts off gas if flame fails unexpectedly

REFERENCES

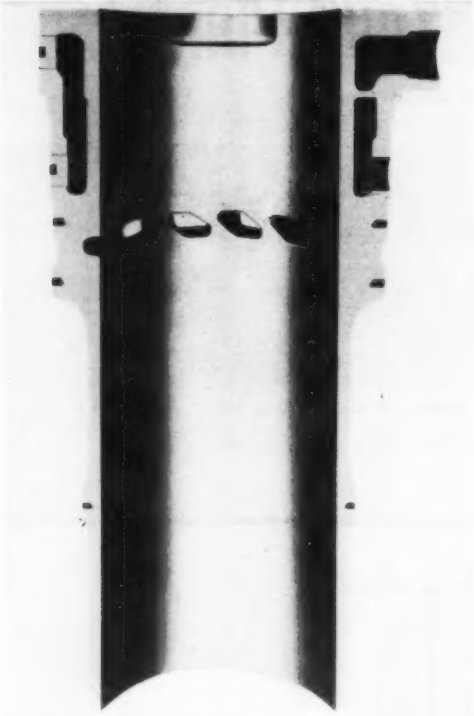
Safeguard your plant by getting more information on gas hookups from:

Factory Mutual Engineering Division, 184 High St, Boston 10, Mass. *Loss Prevention Bulletin No. 11.88.*

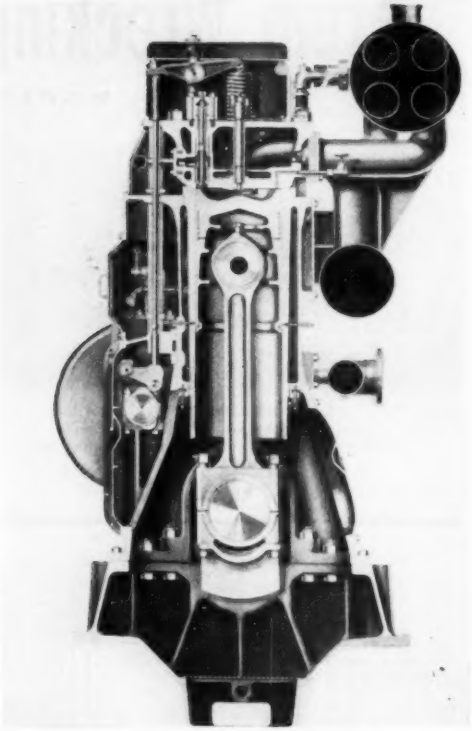
American Standards Assn, 70 E 45th St, New York 17, N. Y. Code for *Pressure Piping*, B31-1.-1951, and *Installation of Gas Piping and Gas Appliances in Buildings*, Z21-30.—1950.

Cast Iron Pipe Research Assoc., Chicago 3, Ill. *SMJCIP&F, 1950 Revision.*

National Safety Council, 425 N Michigan Ave., Chicago 11, Ill., furnished wiring diagram for purging.



2-CYCLE liner with self-contained water jacket. Cooling is at top near combustion zone to carry away destructive heat



4-CYCLE liner is cooled further down. Cylinder in compression-ring area is oiled by forced lubrication through liner

The Life of a Diesel Liner

Liners have "life expectancy" same as humans. And no one is in a better position to know what that is than the operating engineer. He can shorten or lengthen the liner's life

By **HARRY P YOUNT**, *Worthington Corporation*

► Do YOU KNOW when your diesel or gas-engine liners are worn out and due for replacement? This question is important to you as an operating engineer because it concerns the economical and safe running of your engines. Further, deciding to replace liners means the company must cough up a lot of money, so you'd better be right the first time.

Sometimes an engineer is convinced he needs new liners, but has a hard time selling the front office. One reason may be that he has no ammunition to help him win the battle. Before spending money, the front office wants facts in black and white.

Cylinder Wear. Average engine runs about 5,000 hours in a year. Average liner wear (taken at top where it's greatest) is from 0.001 to 0.003 in. per 1000-hr operation.

This rate of wear depends on many things, including load carried, type of lubrication, rate of feed from lubricators, manner of filtering intake air, etc.

Considering all these factors, you can expect an average total liner wear, dur-

ing a year, of 0.005 to 0.015 in. Next, determine what should be maximum liner wear for your engine under good, economical and safe operation. A conservative figure should be 0.005 in. per in. of liner diameter. An outside figure is 0.010 in. per in. of liner diameter.

For a 16-in. liner, minimum wear would then be 0.080 in. and maximum wear about 0.160. Figure to use for your engine depends on routine indicator-card readings. They show loss of compression and combustion pressures, due usually to tapered liners. Also, check any increase in lube-oil consumption which worn liners might cause. This is important.

It's important to know amount of blowby into the crankcase. Blowby always contaminates lubricating oil, which in turn causes more wear. You should know when such blowby gets beyond the safe stage and rings no longer maintain a proper seal on the liner wall. To pass this safe stage means that blowby is so bad that the oil seal on liner wall is destroyed. Thus a vicious cycle is set up which can lead to scored pistons and liners, together with all the grief that usually follows.

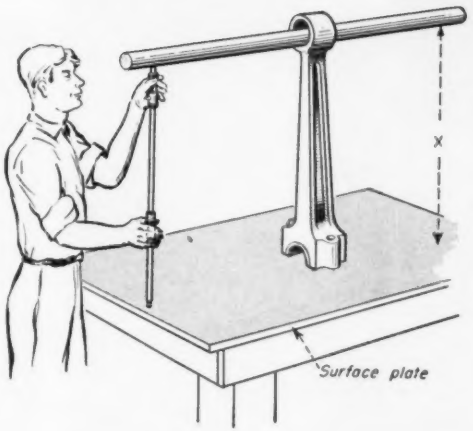
Rate of wear mentioned above, 0.001 to 0.003 in. per 1000-hr operation, will increase with age. The older the liner and the more it's worn, the harder it is to hold a seal on the liner wall.

I would hesitate very much to continue using a liner that had worn as much as 0.100 in., regardless of what the indicator cards might show or what the other indications were.

Liner's Life. This brings us to how long a liner will last. If the figures above are manipulated, you can see that by dividing the rate of wear per year into the permissible liner wear, you arrive at any figure from five to 32 years. That is, by dividing 0.015 in. wear per year into safe liner wear of 0.080 in., the liner will last for 5 1/3 years. But if we divide wear rate of 0.005 in. into 0.160 in. permissible wear, the liner would last for 32 years.

I don't believe 32 years of liner life could practically be achieved, under ordinary conditions. But, operating engineers are ingenious and resourceful men. Perhaps this liner life has been achieved and surpassed, our imagination to the contrary! Am I right?

EDITOR'S NOTE: *How much wear do you allow on your liners before renewing them? And what do you go by? Some of the things mentioned in this article? Or do you have your own rule of thumb? Let us know. We'll publish your answers in "Argument Corner," or make up an article from your letters. We are sure your answers will be interesting.*



Measuring Rod Wear

Connecting rods for diesels often wear unevenly, but it isn't always easy to measure amount of uneven wear. Yet that's the kind of wear to correct since it causes piston to tilt and wear at one side on top, at another side on bottom.

One reliable way is to remove the connecting rod and stand it on a flat surface. For accurate results, surface should be a surface plate or some other flat machined part. After bearing shell is removed, clean surface plate and surface of connecting rod before standing connecting rod up in vertical position as shown.

Select a round rod and check whether it is straight. One way is to roll it on the flat surface. Another is to balance it in the connecting rod as shown, and take micrometer readings from plate up at one end only. Turn rod one-quarter turn, take another reading. Do this for about four positions. If all readings are same, rod is straight.

Then measure from plate up on both sides of connecting rod. Any difference in distance shows that bushing on wrist-pin end is worn tapered or that connecting rod is slightly bent.

Wear at crank bearing can also be uneven. If bearing metal is removable-type shell, it's just a case of removing the shell and measuring thickness with small micrometer. Because shell is curved, place a small steel ball (from a ball bearing) on inside surface of shell. Then after miking, subtract diameter of ball from measurement.

If crank-end bearing is babbitt-poured into connecting rod, find uneven wear by measuring from surface plate to bottom of shell with inside calipers or inside micrometer, while in position shown.

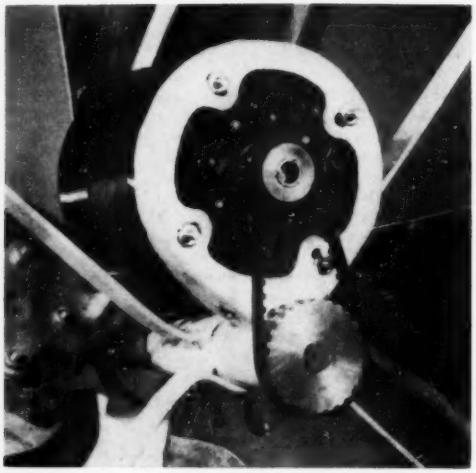
To correct uneven wear on wrist-pin end, renew the bushing. If you have no new bushing and job must go together, bushing can often be pressed in with unworn part on bottom. Make sure oil holes line up.

Crank-end removable-shell that's worn on one side is easily removed with new shell. If in an emergency you have no new shell, turn old shell around after scraping it even.

C MORGAN JONES *New York, N. Y.*

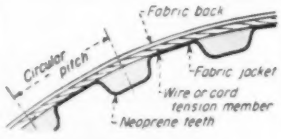
AUTHOR holds sample toothed belt, machined pulley. Belt's steel tension member spells accurate timing and high strength

Toothed Belt Makes Bid for Small...



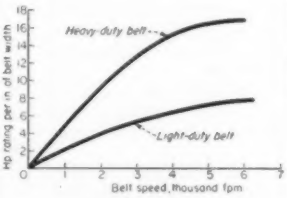
TOOTHED BELT allows a smaller drive and less costly motor for this fan. There's no slippage and very little power loss

Belt With Teeth Gives



CONSTRUCTION

Steel or cord tension member, at the base of teeth, is important feature of belt's construction. It prevents belt teeth jamming in pulley grooves



HP RATINGS

These are conservative hp ratings for low and medium speeds. Possible to operate the belt up to 16,000 fpm

Here's latest addition in the belt-transmission field. Belt has teeth that mesh with axially grooved pulleys; gives on-the-nose timing between shafts. There is no slippage or creep of belt. High speeds, even to 16,000 fpm, are OK

By **RICHARD Y CASE,** *Manager*
Timing Belt Division, U.S. Rubber Co

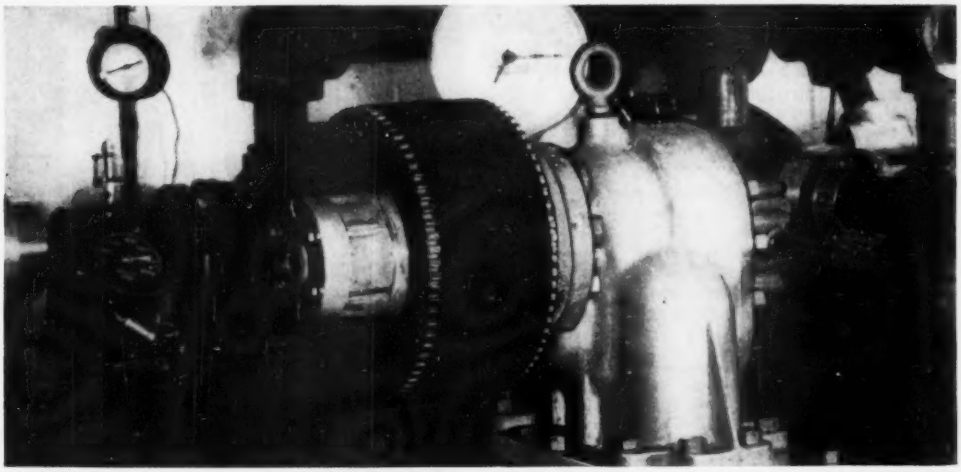
► ENGINEERS have long realized the possible advantages of a belt that offers a positive drive. In short, it would be a transmission medium that combined the flexibility of a belt with the positive drive of gears. Answer is not simply placing teeth on a conventional belt's surface. If this is done, a belt results that changes its circular pitch (distance between tooth centers) as it passes around pulleys. Further, if belt material stretches under load the belt-teeth will not engage pulley grooves, making practical operation impossible.

Construction. Sketch at left shows one practical way to combine positive drive, a timing feature, belt flexibility. Here we have what is essentially a flat belt equipped with teeth equally spaced on belt's surface. Teeth are designed to mesh with axially grooved pulleys.

Heart of this construction is a load-carrying tension member that lies just beneath the fabric cover on tooth side of belt. This tension member is helically-wound single layer of cabled steel wire or stretch-resistant cotton cord. It is molded in a thin layer of neoprene to which the teeth are integrally vulcanized.

Let's look at the significance of this simple tension member. First off, if no definite tension member were used, belt's pitch line would change as it

...and Large Power Drives With Accurate Timing Over Wide Speed Range



HEAVY LOADS and high speeds are no problem for the belt on this pump drive. Many applications over 100 hp have been handled. Belt width is in one piece rather than series of small sections. Can be used on fixed centers; belt won't stretch

Positive Lightweight Drive

passed around pulleys. Pitch line is neutral plane in the *tension* member that separates tension and compression zones when belt is flexed. By establishing a built-in tension member and placing it at the inner side of belt, the circular pitch and pitch line are not appreciably changed by flexing. That holds, even when belt is run over extremely small pulleys.

Timing. This form of belt construction lends itself readily to timing applications. Timing means more than simply holding a given speed on output shaft over a period of time. In this case, because of relatively constant pitch line it also means instantaneous linear speed is held constant. This is important in many applications where any change in instantaneous speed would leave its effect in the item being produced.

Although this type belt is well suited for timing applications, it is also fitted for straight power transmission where the timing feature is relatively unimportant.

Pulleys for this belt can be made of cast iron, steel, powdered metal, aluminum, die-casting metal or plastic. They can be manufactured by shaping, hobbing, milling, casting, molding or extruding. Pulley teeth must be carefully matched to the belt. Diameter of pulleys may be as small as ½ in. or as large as required. Check pulley grooving with supplier before buying.

Flanges are generally provided on one or both sides of the pulleys to guide the belt. Reasonable alignment of shaft is essential in applying this type of belt.

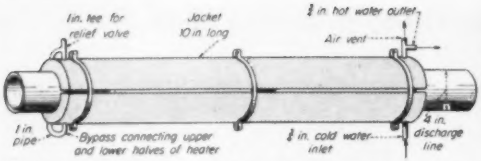
Advantages. Applications over the past few years have shown up several features of the belt that make it desirable as a general power-transmission medium. Since the belt makes positive engagement with the pulleys, slip, creep and speed variation are eliminated. Belt is efficient at speeds down to inches per minute or at high speeds to 16,000 fpm.

The built-in tension member permits belt to operate on fixed centers without take-up adjustments. Belt can be installed and removed by hand. Because belt tension is not critical, extremely low bearing pressures result. This in itself permits use of less expensive bearings plus cutting power loss.

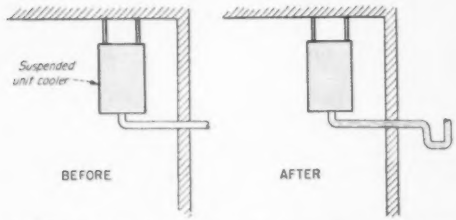
A toothed belt of heaviest construction, 1 in. wide, weighs but 1/10 lb per ft. Belt thickness, exclusive of teeth, is less than 3/32 in. This combination of strength, flexibility and lightness makes the belt well suited where weight and space saving are important. Light weight and flexibility allow operation at high speeds. And because of belt's thinness, virtually no heat is generated by flexing.

Positive grip on limited pulley areas makes it possible to design high-ratio, short-center drives without risk of slippage. Fixed center drives are a natural since gripping power does not depend on friction or tension.

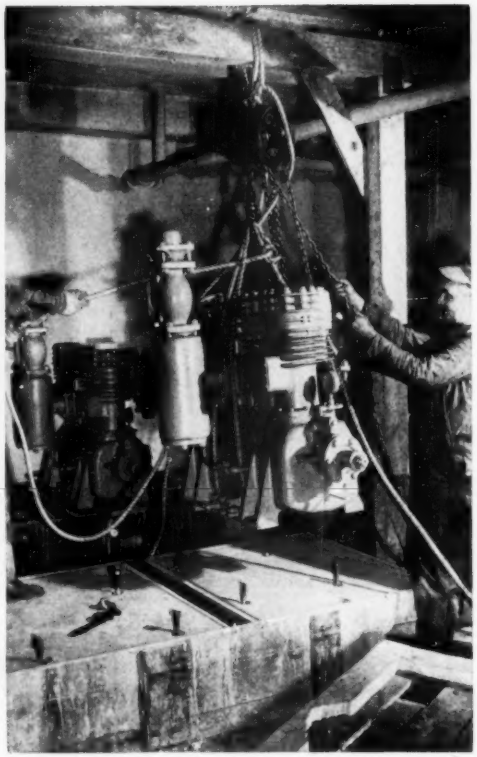
Applications. Following are a few of the many applications where the belt does a good job: *Centrifugal separator* using a 2-in.-wide belt. Here, a 500-lb rotor is driven from a 25-hp motor at 3500 rpm. *Cement block machine* driven through a toothed 3-in. belt operating over 4- and 8-in. pulleys. *Air pump* operating from a 128-hp motor through a 7-in. belt. This drive uses pulleys of 3¾- and 16¾-in. diameter on 15½-in. centers. Many future applications in the power field will see this new belt take its place as another member in the mechanical power transmission family. The reduced maintenance angle appeals to operators.


1 in. tee for relief valve
Jacket 10 in. long
¾ in. hot water outlet
Air vent
1 in. pipe
Bypass connecting upper and lower halves of heater
¾ in. cold water inlet
¾ in. discharge line

COLD WATER enters lower half of shell, then picks up more heat in upper half from hot discharge-pipe it's fastened to



NO LOOP in drain line let cold air blow through to outside. Loop placed outside now keeps cold in and heat from entering



NO VIBRATION expected here since foundation is well built and holding-down bolts will keep the compressor from dancing

Refrigeration Trouble Shooting

By **C. T. BAKER,**
Consulting Engineer, Atlanta, Georgia

- ***How was fouled-up quick-freezing plant for turkeys 'unfowled'?***
- ***What remedy stopped compressor discharge line from corroding,***
- ***What carboned up valves of refrigerator compressor?***

These are just a few questions this consulting engineer runs into and solves while visiting plants down south around Georgia

CASE NO. 1—Freezing Turkeys Fouled Up

This plant was small and simple, designed solely for freezing turkeys. The seller's contract stated the plant would freeze 3000 lb of turkeys per 24 hours, if delivered to freezer at 40 F. Freezer-room temperature was to be held at minus 15 to 20 F.

Freezer room was insulated with 8 in. of vegetable cork. Cork was set up in two courses of 4-in.-thick board, finished with portland cement. Equipment installed was a well-known make, as good as could be purchased anywhere. Yet, the plant did not operate as well as purchaser thought it should. A number of things contributed to this plant's failure to perform as guaranteed, as I found after checking.

Faults. After investigating, some interesting facts were brought to light. Here are some of the worst: (1) No flexible joint in Freon-12 compressor discharge line between compressor and evaporative condenser. That left nothing to absorb vibration of high-speed multi-cylinder compressor. (2). No solenoid valve on liquid line between condenser and room cooler to close when compressor stopped if room temperature hit low of minus 20 F. (3) Compressor not bolted to its foundation. (4) Drain pipe from pan below suspended-type unit coolers had no gooseneck seal to prevent cold air

escaping. Line was for draining water from automatic defrosting operations and extended outside the building. (5) Openings in insulated wall (for suction and liquid lines to pass through) not sealed after piping was installed.

Remedy. Here's how I corrected defects in this small freezer plant.

First, we leveled compressor and bolted it securely to its concrete foundation. While this was being done, a flexible section of piping was installed in the discharge line. These two operations completely stopped all vibration of both the compressor and piping.

Next, we placed a water-seal loop on drain from unit coolers. This eliminated the cold air blowing through to outside. We also stopped entrance of warm air around cold-storage door and through openings around pipe and conduits that pierced freezer-room walls.

A solenoid valve was then placed on the liquid line near the freezer room. We wired it to open and close with compressor's starting and stopping. This prevented evaporators from filling solid with liquid, during compressor off-time.

New seals placed on freezer door protected the room against warm air leakage into freezer from outside.

Questions. Usual questions when situations of this kind come up are: "Why should the seller have to make so many corrections? Why wasn't work done according to Hoyle in the first place?"

Why can't we design and construct a small freezing plant correctly after a quarter of a century of accumulated experience in quick freezing? I mean a plant that will not require so much attention and additions when it has operated only 30 days.

"Why," asked the purchaser, "was it necessary for me to hire, at my expense, a consulting engineer to locate these troubles and to supervise the work of correcting defects and omissions of the seller? Why did I have to advise the seller that unless corrections were made and plant put in shape, I would bring suit to compel him to make changes?"

Answer. Actually, there is no valid excuse for such practices on the part of the seller. Besides, it's very poor business. It always backfires and never pays in the end.

CASE NO. 2—Corroded Discharge Lines

Some ice plants have problem of keeping supply of warm water for ice-can dump. Dump may be either spray or submergence type. Many years ago a method of heating water for this purpose came into general use. Trick was to harness the heat in discharge gas leaving the compressor.

Here's how plan worked. A large-diameter steel pipe was placed over a 20-ft-or-so length of discharge pipe. The ends were closed up and a water inlet connected at the shell's bottom and an outlet at the top. This arrangement still is used in plants. It insures all the warm tempering water needed to loosen ice from side and bottom of cans.

Trouble. Some years ago I had one such jacket removed from the discharge line of a 50-ton ice-making compressor. After examining it, I was surprised to find discharge line badly pitted. About one-half of the original pipe thickness had been eaten away. The wall thickness at several points had been reduced to the danger point by corrosive action of hot water and entrapped air. We installed a new section of discharge pipe. Then we scrapped the old heater.

Later, while inspecting a large ice plant in another state, I noticed that this plant also used the same method of heating water for tempering cans at the dump. When I told the chief plant engineer about finding the discharge line corroded in another plant, he promised to investigate his system as soon as the ice season closed.

"Yes," the chief reported, "my line is also badly corroded." But because he couldn't do without hot water in his plant, he had to figure out something else. His solution is shown in first sketch. It works just as well as his old heater. Besides, it gives complete protection to the compressor discharge pipe.

In laying out the new heater, he made the surface about 25% larger than the original heater. That insures adequate capacity in the improved design.

This new heater is made of plate iron and divided into two halves, connected by means of a short pipe as shown. Water enters lower half at the bottom and leaves top half at the top. If needed, a thermometer can be placed on the hot-water outlet to show the leaving temperature.

Sketch shows important construction details. With this type of heater, the ammonia discharge line is fully protected from damage, because water does not contact the line.

CASE NO. 3—The Dynamo Oil

At times I'm called into a plant to straighten out some problem that has no business there in the first place. It's usually a boner on someone's part—but invariably turns out to be costly to the owner.

One morning the owner of a small hotel called and asked me to drop in before going to my office. In his plant, I found a 10x10 ammonia compressor that had always developed more than rated capacity. But I learned that it gradually began to fail.

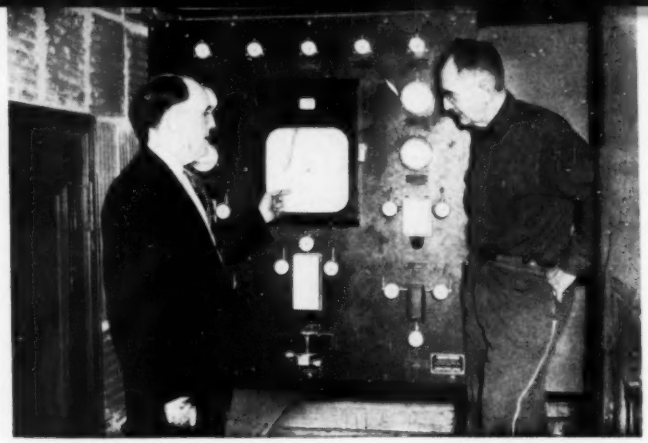
Wrong Oil. There was nothing to do but shut down and tear the machine apart. I soon found that the discharge valve was leaking badly, causing the compressor to overwork and yet do little useful work. The leakage was caused by carbonized oil and carbon deposits. Other oil residues were everywhere. First, I took an oil sample from the crankcase. Just as suspected, it proved to be ordinary light bearing oil. It had a low vapor point and a high freezing point. That kind of oil had no business being used in any refrigeration compressor.

It took several hours of hard work to clean up the compressor and regrind discharge and suction valves, also safety head seats. Later, it was an even bigger job to remove the accumulation of light oil from the evaporating coils.

Mistake. Yes, the oil company admitted they sent the wrong oil. They filled an order asking for "a barrel of ice-machine oil," which can be almost anything. I learned that the engineer didn't even check whether oil was kind he expected. He just drained old oil from crankcase and refilled with new. What was his reason? "I didn't have time for checking," he told me in an angry tone. "You dope it out."

Want to smooth out your air-conditioning system? Set up your operations on a basis of constant checks, use ample instruments, and go to many automatic controls, well placed

By THOMAS J BARRETT
Superintendent of Building
Waldorf-Astoria Hotel



ADEQUATE CONTROLS and a central panel board; good supervisors like Dick Butler, chief engineer, Al Cross, operating engineer, help system meet design guarantees

Continual Maintenance Program

► AIR CONDITIONING has always been a 5-point job that covers the maintenance of: (1) temperature (2) humidity (3) cleanliness (4) ventilation (5) circulation. All these conditions you hold to levels best suited for your plant. At the Waldorf-Astoria comfort is our chief concern.

When our latest addition to handle the Empire Room went in, we called for as ample a design for comfort conditioning as we could get for the money. drawing on facing page. To get top performance out of it we put in as many operating controls as we felt made good sense. Best results from any air-conditioning installation can come only from a blend of good operation and close maintenance.

Good Operation. When you have a load such as the Empire Room carries—one time a banquet group, the next, a dance—you have a widely varying end condition, and ample automatic controls are a must for good operation. What's more, they pay off at the fresh-air supply end. You need a running comparison between wet-bulb and dry-bulb temperature to know the most economical proportions of fresh to return air. The right amount of each means less work for your conditioning equipment and lower operating costs.

One fundamental operating rule stands out. Never admit outside air directly to a conditioned room. It adds to the sensible heat load, runs up your costs.

You hear now and then of freeze-ups and similar troubles in supply air ducts caused by outside air under winter conditions. A heating coil in the path of incoming air prevents this. We've done several things as you can see, drawing, facing page, to get around any headaches of this sort. First off, we've got an automatic 4-position damper at the outside air intake. We can leave one section open for minimum fresh-air requirements when we're operating, and close the whole thing down when we're not. When we do shut down the main fan, the automatic damper closes, so outside air no longer has free access to the duct. As a second safeguard we've put in a thermostat control that feeds steam to the preheat coil if duct temperature falls below 50 F. This gives positive insurance against freeze-up.

Right at this point you'll find one of those cases where good maintenance is good operation. Something like—What came first, the chicken or the egg? We mean the job of making sure heating coils have good traps working properly. Condensate backing up in heating coils keeps you from getting your full money's worth in performance. In our plant we use a vacuum return system on condensate because we feel it gives us a more positive removal of condensate.

Whatever you do, never throttle steam supply to a coil unless it's designed for it.

Air filter operation, to our way of thinking, is one more place where good maintenance is good operation. Clean filters, working at best efficiency, mean lower housekeeping costs, less frequent paintings—highly important considerations in the hotel business. Remember, allowable air speeds differ for the various filter types on the market. Check the air speeds through your filters, and be sure they remain within the allowable range. Then you know your filter is working under the right conditions for good performance.

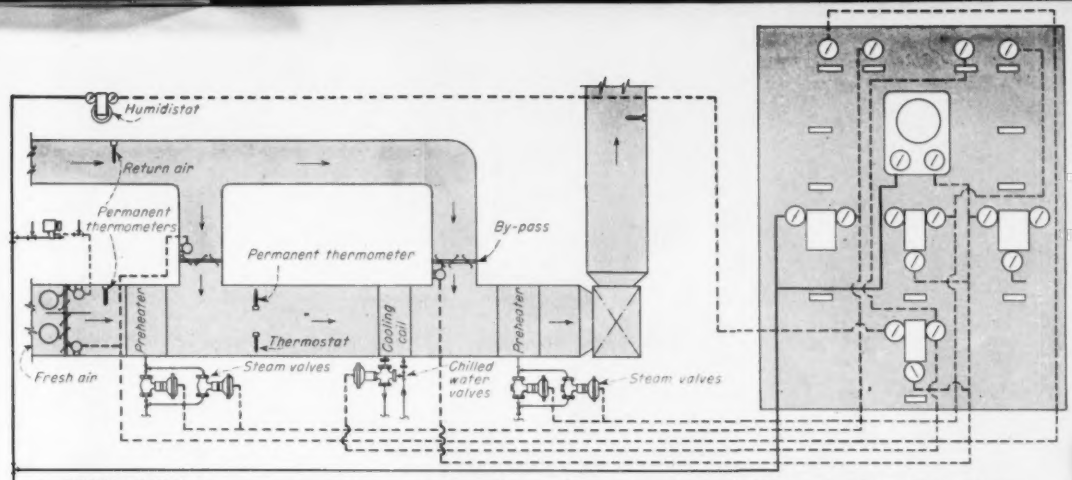
Next, check up on pressure drop across filter banks. Differential draft gage between filter inlet and outlet chambers gives you this information direct. It tells you when filters need cleaning, avoids overloads on your fans. Find out the range of pressure drops your filter should work under. When higher pressure shows, clean your filters.

We put in an alarm system in the differential draft gage hookup across the filter banks. This system turns on a red warning light when pressure gets beyond a preset level. Then we pull out the dirty filters, replace with a set of clean spares and take off the dirty ones for cleaning.

We still check the setting of our automatic air damper daily against (1) its metered position and (2) fan action when we throw the switch on. This may sound needless but we think it's low-cost maintenance insurance.

Good Maintenance. Much of our daily operating procedure you could call preventive maintenance. But there are still a lot of nonoperating details that need periodic attention to get the best life out of an air-conditioning investment.

Fans and ductwork need regular attention. We clean them, go over sur-



PROPER DESIGN for your load conditions is vital to good results. But you can throw it all away by failure to equip system with enough meters and other instruments to give you a running check on performance, help you to isolate trouble

Gives Best Air-Conditioning Results

faces where possible to remove noise-making obstructions and spot vibration sore spots. Once a year we take readings at diffuser outlets to determine if each outlet is supplying its rated output. A properly balanced system does more than give good distribution. It avoids unnecessary overload in any part of the system.

Meters and other instruments need periodic checking. You always want to be sure that the readings you're getting are right. We put in permanent duct thermometers because we believe they give quick checks on system performance, help us isolate trouble spots if they develop. They come in for the same periodic checking.

We've still another maintenance problem connected with our control system. Compressed air serves as the motivating force and we get it to the controls through copper tubing. Our instrument air compressor is down in the basement and draws in a fairly wet air. At first startup, our compressed air lines suffered from condensation. We put in bleeder legs at each instrument to collect condensate and blow it out much as you handle a drip leg in a steam system. Then we put in drip legs at the bottom of long, vertical compressed-air-line runs. Lastly, we rigged up a special moisture-removal device, first with silica gel and later an inlet air-condenser chamber using coils carrying chilled water from our refrigerating cycle. This we watch closely.

All in all, with the combined tools of good operation and good maintenance you can get good performance from any well-designed air-conditioning system.

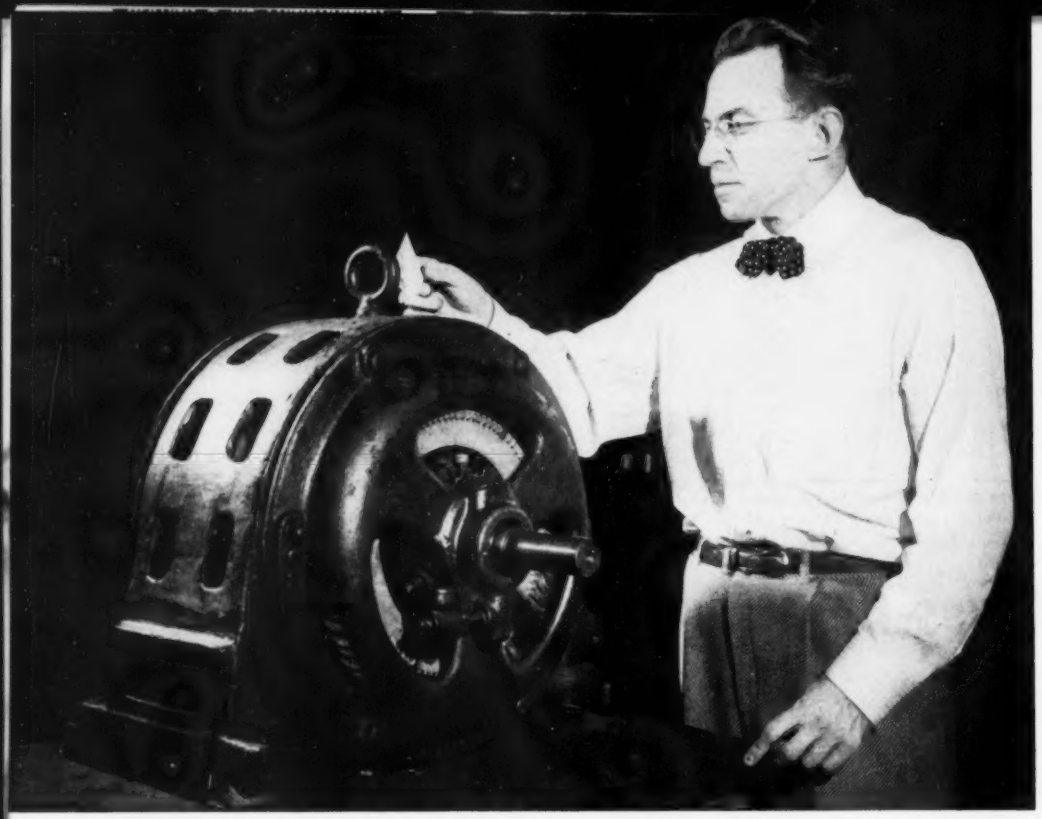
Chilled-Water Conditioning

When you spray chilled water into the air to cool and dehumidify it, you pick up moisture from the air and get with it two problems: (1) removal of the added water volume (2) treatment of the incoming chemicals, principally oxygen, carbon dioxide, sulfur dioxide. Corrosion from these gases becomes a primary problem during the dehumidification period. Don't kid yourself about it; you need chemical water treatment to combat these conditions.

Suppose, though, you circulate chilled water in a closed circuit through coils in an air washer. Then you play water over the outside of the coil. Sure, your chilled-water circuit is safe but the air washer itself needs protection from the attacks of outside water.

Vacuum refrigeration systems produce chilled water by putting the water under a high vacuum. Then the water flashes and the evaporation cools and dehumidifies your chilled water. But the flashed water leaves its solids behind and chemical concentration builds up. If you spray this water in direct contact with the air, air-borne moisture condenses and dilutes the chilled water. This pickup partly offsets the concentration effect of the flash chamber, but the dissolved gases create their own problem of corrosion.

If this same chilled water goes through closed coils in an air washer, the concentrated salts are not offset. Then scale forms within the coils and you've got this for a water-treatment problem.



1 Author checks report-ticket attached by field man. Here the complete stator rewind and rotor overhaul is needed. Stator work includes stripping old winding, insulating slots, winding and installing new coils, dipping, baking, testing

Rewinding a 3-Phase Induction Motor

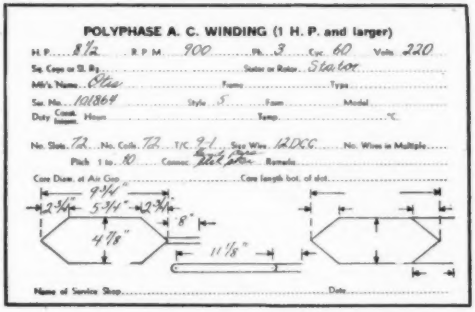
Part 1: This 6-Page Picture Trip Shows Each Step in Rewinding a Stator

By **WALTER J PRISE**, *Chief Engineer, The Maintenance Co, Inc*

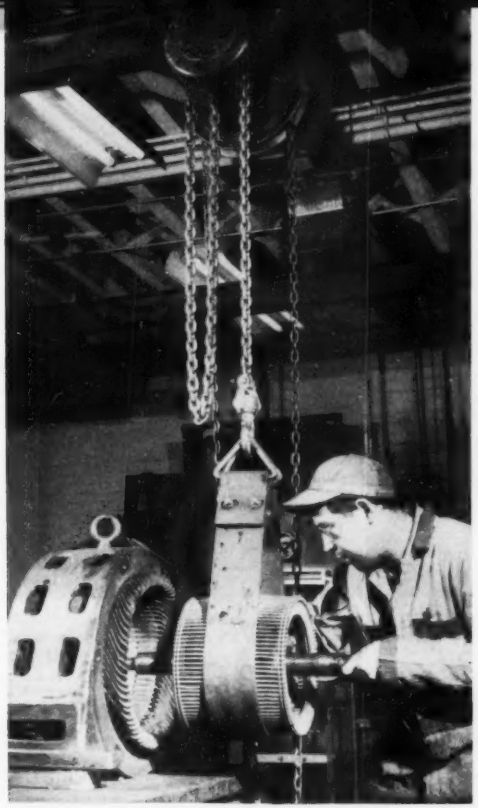
► THE SQUIRREL-CAGE induction motor is a tough baby. It can stand rough treatment . . . up to a point. Prolonged heavy overloads, not checked by motor protective devices, mean the motor will in time join the march to the rewind shop for an overhaul.

You may rewind your own motors or ship them to a motor repair shop. In either case this article and those to follow will help you. If you rewind your own, you'll get an insight into how one topnotch shop handles the job. And if you farm out the work here's the kind of job you should get for your money.

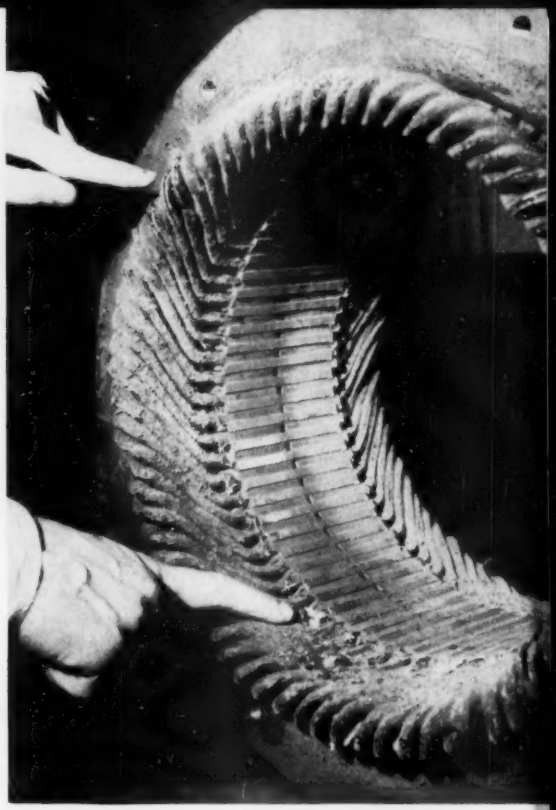
It's important that the rewind be kept as close as practical to the motor manufacturer's original specs. Sloppy shortcuts, different wire size, cheaper insulation will show up in shorter motor life after the unit is back on the job.


POLYPHASE A. C. WINDING (1 H. P. and larger)
H.P. 8½ R.P.M. 900 Ph. 3 Cyc. 60 Volts 220
Sq. Cage or Sl. Rg. Stator or Rotor Stator
Mfr's Name Otis Frame Type
Ser. No. 101869 Style S Form Model
Duty Cont. Hours Temp. °C.
No. Slots 72 No. Coils 72 T/C 3-4 Size Wire 12DCC No. Wires in Multiple
Pitch 1 to 10 Connec. Multiple Remarks
Core Diam. at Air Gap Core length bet. of slot
9 3/4"
2 3/4" 5 3/4" 2 3/4"
8"
4 7/8"
11 1/8"
Name of Service Shop Date

4 Typical data card, provided by National Industrial Service Assn (NISA) to member shops, eases motor rewinding job

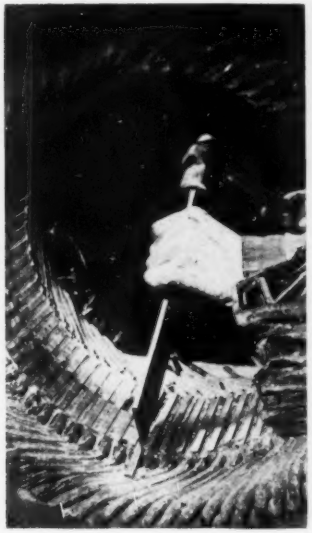


2 After end-bells are off, rotor lifted out with chain-fall. Leather strap protects rotor windings from further damage



3 Stator insulation is burned, coils shorted by hot babbitt thrown from rotor. Babbitt used to hold rotor bolts snug

5 Check all connections. They should jibe with motor manufacturer's specs

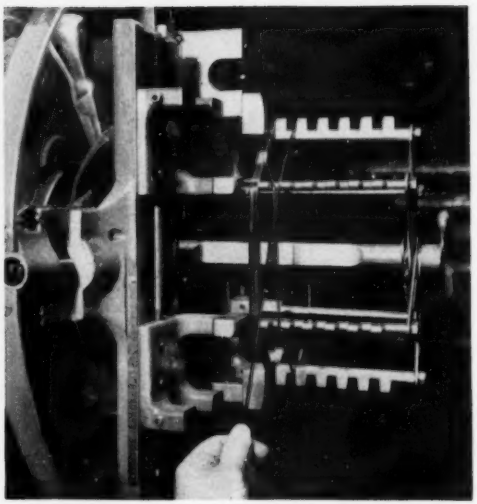


6 Start stripping by knocking out all wedges, leaving the coils free to lift

7 Here it's easy. But with closed-slots, clip ends and burn out coils in slots

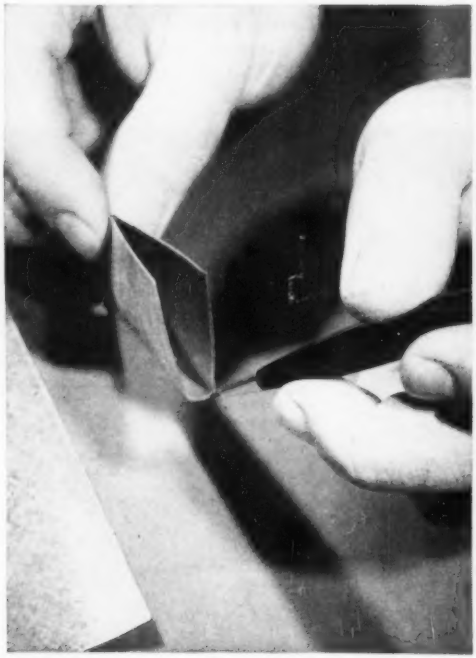
More on next page

8 Coil winding is next step. This adjustable winding unit shapes each coil to dimensions on the data card, Fig. 4



9 Coil-winding closeup. One coil in group of three complete; the second coil started. A far cry from using wood forms

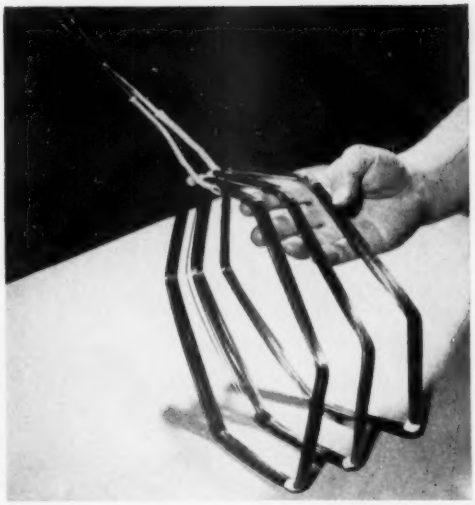
Coil-Winding Today Is Done on an Adjustable-Form Machine That Shapes



12 Insulate each slot before placing coils. Use fish-paper about 0.015 in. thick. Double-bend increases coil area

13 Use fiber strips under fish-paper. Slip treated-cloth insulation atop fish-paper; let it stick up about ½ in.

10 Coil-groups slide out easily after the form is collapsed. Winding insulation stands up well under normal handling



11 Three coils make a coil group. Additional insulation is slipped over leads. The coils are now ready to install

Each Coil While Winding in Groups Ready for Slipping Into Stator Slots

14 Installing first 3-coil group. Note how the cloth feeder eases installation plus protecting coils from abrasion

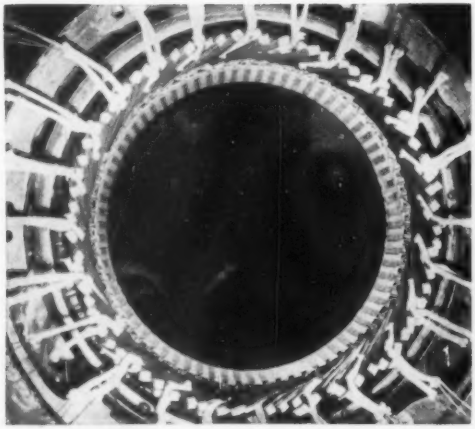
15 Tapping coils in place prevents vibration later. Install only bottom half of coils till the first coil pitch is in

More on next page

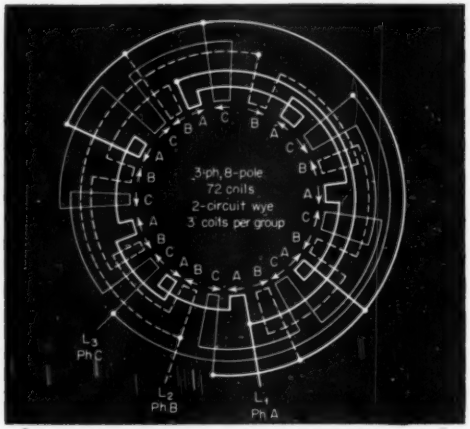
16 Fiber strip separates top, bottom coils. After installing top side of each coil, cut off excess cloth and fold over

17 Close slots with fiber wedges. Use wedge-driving tool if slots are long. Lay cambric cloth between phase groups

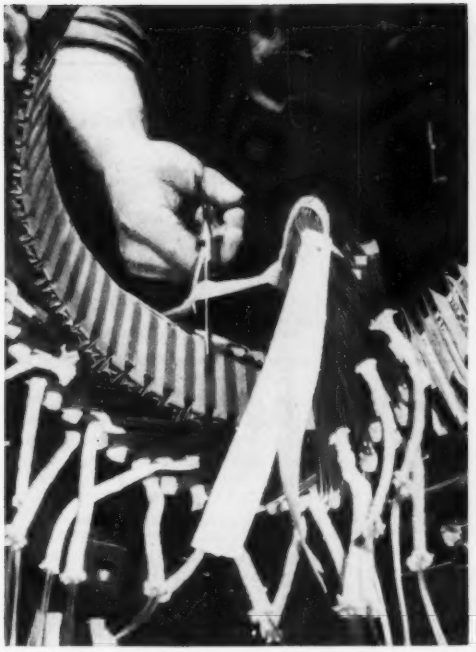
Laying In Coils and Closing Slots Are the Make-Ready Steps for Connecting Phase-Groups to the Motor Leads



20 Here's completed stator ready for connecting. Fan out leads, check with hookup diagram before going further

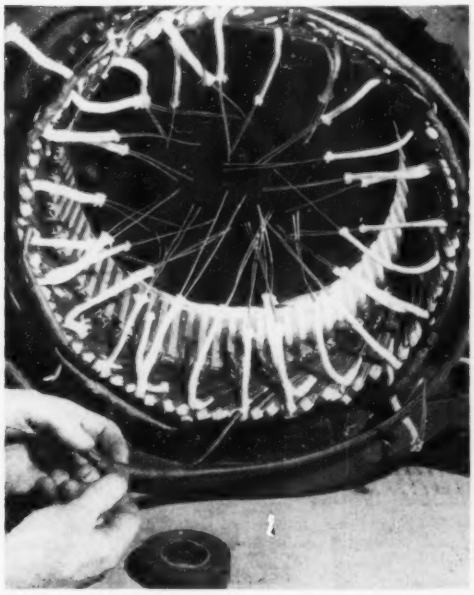


21 In this case we have a 2-circuit 8-pole hookup. Trace through and note that each succeeding group is reversed

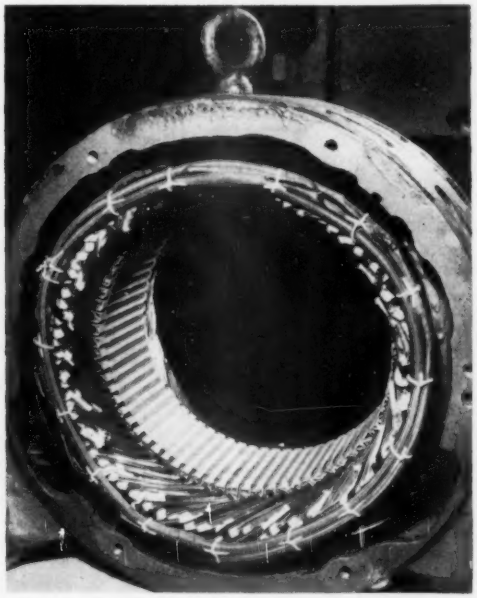


18 Top sides of first coil group are tied up till all coils are in position. Now, ready to sink these coils in place

19 All slots full, once these last coil-sides are in place. Don't start connecting-up till all coils are wedged snug

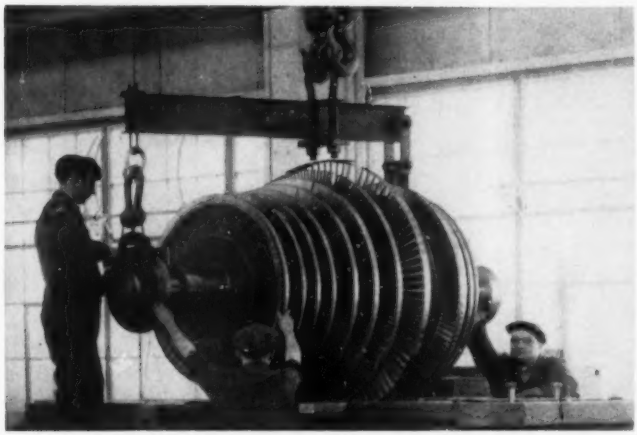


22 Solder, tape all connections. Here the feed from motor's terminal block ties to two coil circuits on same phase



23 All connections completed and leads laced together. Next step is dipping, then baking, assembly and finally testing

PRACTICAL IDEAS...*here's the trading post for your*



Here's A Very Handy Lift Bar

FOR LIFTING heavy pieces of machinery, here is a reliable lift bar. Shackle bolts at end hold wire slings, depending on length needed. To balance machinery when center of gravity is to one side as in this rotor, U-hook slides to any position needed along channel iron. Just take enough strain on load to find center of gravity while sliding U-hook.

When load is balanced, tighten clamps against channel iron to lock hook in place. This is safest and handiest rig I've seen for lifting odd pieces.

CARL HOLTZ *Milwaukee, Wis.*

EDITOR'S NOTE: *We're safety conscious, too. The rig looks mighty good except for one possible weakness. If there should be any tendency for the U-hook to slide from its proper position at the center of gravity, only a little friction would hold it. How about making the cross bar* ABOVE *the beam of heavier stock? And make sure it is fastened so securely to the U-hook that it won't slide.*

Tool Sharpener for Hand Scraper

IT'S A PLEASURE to use a sharp scraper, but a blunt one can waste time. I made the scraper sharpener shown from scrap bits around our shop. It's been in use many years. Advantages are: (1) it produces a keen edge quickly (2) edge of scraper is square, so does not need grinding (3) oilstone is kept flat. There is no guesswork. Keen edge is there every time and desired curve across edge is easily maintained.

Body of tool is aluminum, other parts mild steel.

When in use, place tool on oilstone and insert scraper between holder and body. Allow end of scraper to rest on stone. Place thumbs on holder's lower bar and fingers on scraper. Gripping action presses upper bar of holder against scraper, holding it quite firm. Downward pressure allows the scraper to bear against stone. A few smart rubs produce a sharp edge. A light rub on each side of scraper removes sharpening burr, leaving a perfect cutting edge.

J W TOMLINSON *Toronto, Canada*

Duplex Pump Works Now

WE HAD a repair shop rebuild a small steam duplex pump because we were too busy. Pump worked fine until a load was placed on it. When working against boiler pressure, the right-hand piston made a full stroke to the steam end, but on return stroke, the rocker-arm would slip out of spool-piece and stop the pump.

Repair shop mechanic came four times. He lengthened the valve rod, took lost motion out of steam valves, reset the pump, but had no luck. While waiting for him to make a fifth visit, I checked the pump. I found the spool piece on the new piston rod did not plumb with the rocker shaft in the center-stroke position.

I loosened the setscrew, knocked the pin out, and moved the spool piece one inch toward the water end. After resetting the valves (Operators' Notebook No. 1) I tried the pump against boiler pressure and she operated smoothly without stopping.

Spool piece was overlooked, because that side of pump is against the boiler side and cannot be noticed unless you bend over the pump.

R C CONK *Newark, N. J.*

Paint Prevents Tearing

MOST DRAFTSMEN have at times been troubled with excessive sticking of drafting tape to drawing paper. Then surfaces roughen or tear. Before long, some stock is supplied that adheres badly, especially where the tape is left in contact for long periods.

To eliminate these ills, paint the area of paper, where tape is to be applied, with a dilute solution of clear fingernail polish. The oil-less acetone "polish remover" is suitable for thinning purposes, since it doesn't stain the paper.

When the polish is diluted to the proper consistency, drafting tape may be removed easily and the paper's coated area does not show the painted area.

R F CLOTHIER *Auburn, Ala.*

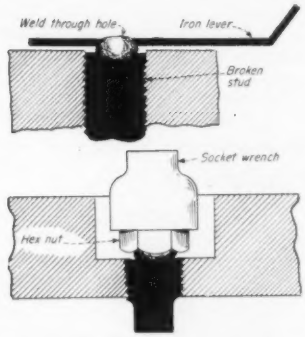
Mercury for Calibrating

BUY several ¼-lb units of mercury when calibrating instruments. This simplifies balancing the instrument. For calculation, 2.05 ml mercury equals one ounce, similarly 32.8 ml mercury equals 1 lb.

L FITZPATRICK *Jefferson City, Mo.*

operating and maintenance short cuts

STEVE ELONKA, *Associate Editor*

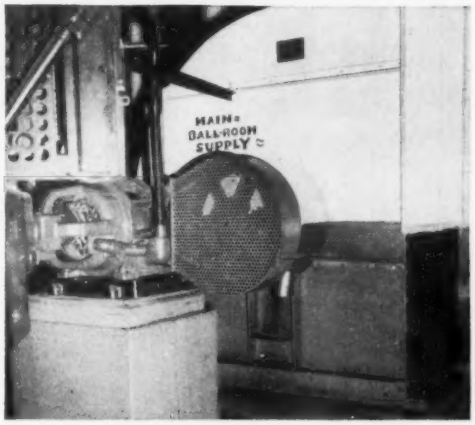


Removing Broken Stud

To REMOVE broken stud from casting, take a piece of flat iron a little wider than stud diameter. Near one end of flat iron drill slightly smaller hole than diameter of stud to be removed. Leave enough stock on other end for sufficient leverage to remove or turn stud. Weld stud through hole as in sketch.

To remove stud or spark plug from recessed hole, take hex nut with hole diameter less than stud or plug. Ream out threads, weld to stud or plug, sketch, then remove stud with wrench.

T J PARMER *Quincy, Fla.*



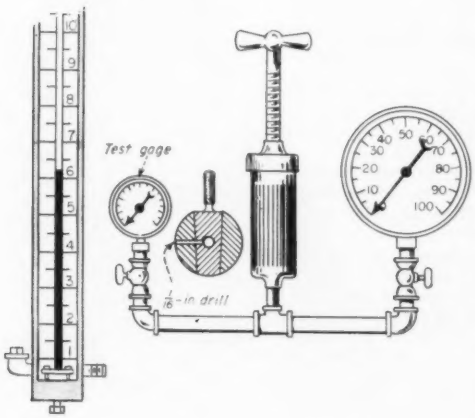
Label Cuts Down Mistakes

WITH MANY BLOWERS in our large hotel plant, we identify each unit clearly by labeling the areas each supplies, as shown in photo. This may sound like a simple thing, but too often mistakes are made in either starting or shutting down the wrong unit. This is especially true where there are many plant operators and mistakes are embarrassing.

An engineer coming on for the evening watch has no reason then to start up the roof ballroom blower, for example, when instruction on bulletin board is to start up main ballroom blower. Keeping guests satisfied in our luxury hotel is too important to allow taking chances. Mistakes can be prevented.

FRANK LOVEJOY *Houston, Tex.*

This Handy Gage Tester Has Many Practical Uses



MY SKETCH, which shows a simple gage tester, is self-explanatory. Note that there is a small hole drilled into the stopcock on one side. A notch in side of handle shows position of hole in valve. When zeroing the gages, handles are turned so the hole in valve aligns with hole in valve body. A few turns on handle of grease gun push oil out these holes. Turning the handles closes the small openings and allows oil to gages.

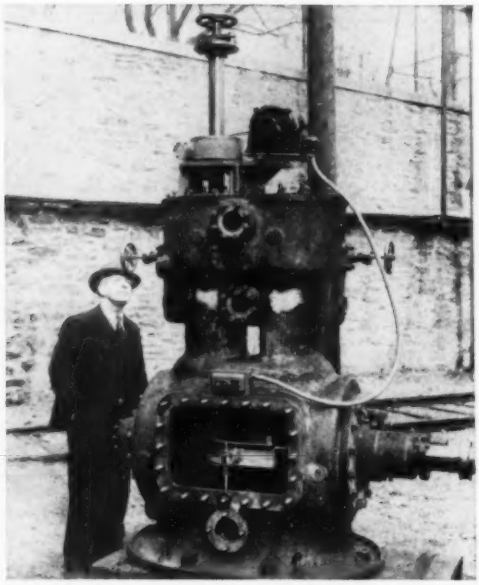
When testing gages, turn handle on grease gun to exert needed pressure. For low-pressure gages, 0-15 psi, replace test gage with mercury column. This gives a closer reading for check.

Tester is not as perfect as commercial-type gage testers, but gives comparisons close enough for most practical uses.

H E WITHER *Osceola, Pa.*

(Continued on page 126)

Begins on page 124



Portable Cylinder Boring Rig Is Handy

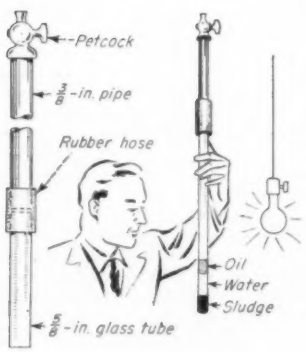
To REBORE badly worn cylinders of ice machine, we use this boring rig. It has a bottom bearing clamp that's fastened to the crankshaft, also to a crankcase door stud. That holds lower end of bar rigid, both vertically and horizontally.

Bar has screw for feeding tool into cylinder, and reduction gearing for slow cut needed for large bores. Electric motor is controlled by switch placed in a handy spot for operator to manipulate.

When dismantled, parts are light enough for carrying and installing on any job. Of course, most important thing when boring a cylinder is to make sure the bar is lined up right. Otherwise, piston will bind. Cylinders are often ruined by mechanics who do not do a good job of first lining up bar.

H JONES *Waynesboro, Pa.*

Sludge-Water Gage Tells Story



To ACCURATELY MEASURE and observe amount of water, sludge, etc, in bottom of fuel-oil tanks, this simple homemade device does a good job.

Immerse in tank with petcock open until tube reaches bottom then close petcock and raise. Wipe outside of glass and there you are—water, sludge, oil—just as they lie in tank. Sample is held in by atmospheric pressure.

To make a tight bond, shellac the ends of tube and pipe before inserting in snug-fitting hose. Or clamp with metal clamps if that's easier to do. I've found many uses for this gadget around our industrial plant.

A CANNON *Laurence Harbor, N. J.*

Use Paper Cups

TRY USING 4-ounce paper drinking cups when testing water samples. They are convenient, unbreakable, with no dishes to wash after and during tests when glassware stocks are not adequate for multiple tests. You just can't beat them.

L FITZPATRICK *Jefferson City, Mo.*

Magnetic Drain Plug Does Big Job

EXHAUST-DRIVEN turbine superchargers on our dual-fuel engines turn 10,000 rpm at full load. At such high speeds good lubrication is a must. For that reason, superchargers have their own oil reservoir and pump.

After learning that some automobiles have magnetic drain plugs in their crankcases, I tried one in our plant. It's a pipe plug with a small horseshoe magnet pushed into the bottom.

So plug serves two purposes. Metallic (magnetic) particles adhere to the magnet instead of circulating through the system. When plug is removed for draining sump, it's only a case of wiping metal particles off the magnet with a rag. I installed such a plug and the expense is well worth the cost.

F ARDOLINO *Brooklyn, N. Y.*

Air-Compressor Cylinder Maintenance

A FINELY POLISHED or glazed surface on air-compressor cylinder wall is not a guarantee that machine won't pump oil. I've found that out through years of overhauling numerous small and medium-sized reciprocating air compressors.

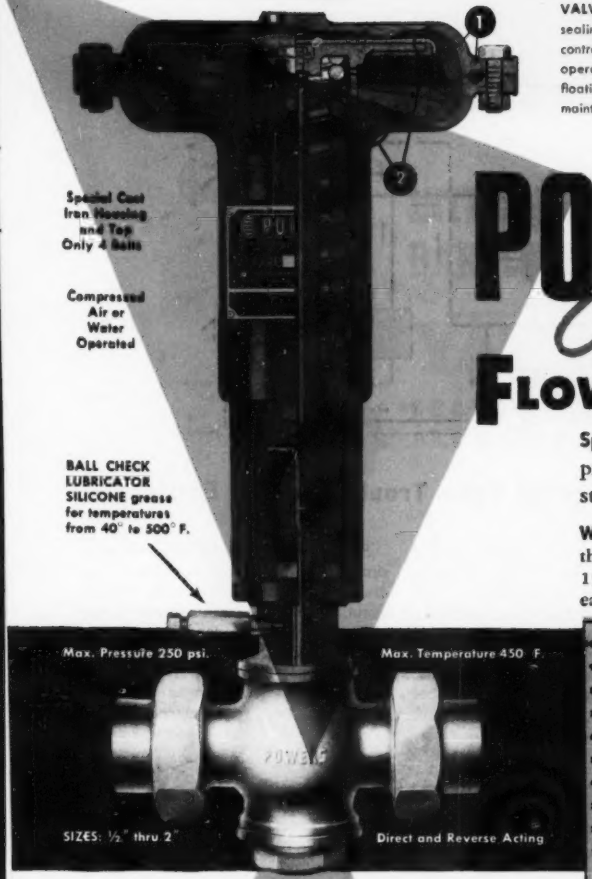
Cylinder walls of some compressors show very little sign of wear. Some acquire a fine finish that most mechanics consider excellent. My experience shows the contrary. I've found that, with new rings on pistons, machines usually pump much more oil than a new machine. Conclusion is that glazed surface is almost a positive indication that machine pumps oil after overhaul.

I found a way to prevent oil pumping. First, run in machines with a fine household abrasive, such as Bon Ami. Mix a little with oil or water and cover cylinder. Allow machine to run until rings and cylinder walls have taken on a soft, matte finish. This gives smooth surface, but removes glaze. It's evident because cylinder doesn't reflect light.

(*Continued on page* 128)

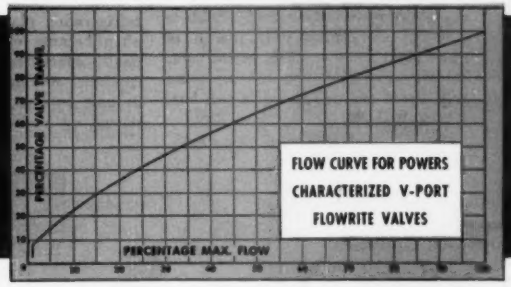
VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

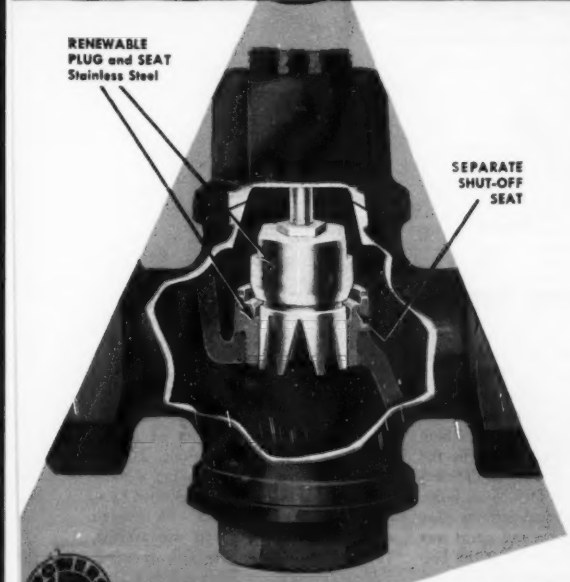
POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—


Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
BALL CHECK LUBRICATOR SILICONE grease for temperatures from 40° to 500° F.
Max. Pressure 250 psi.
Max. Temperature 450° F.
SIZES: ½" thru 2"
Direct and Reverse Acting

Special Flow Characteristics—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

Wide Variety of Valve Sizes—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.





Better Control—Less Maintenance—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

Low Hysteresis—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

Easy to Adjust—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

Easy to Install—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

Easy to Service—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves

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OVER 60 YEARS OF TEMPERATURE AND HUMIDITY CONTROL

a-70

Begins on page 124

After matte finish has been acquired, disassemble compressor and thoroughly wash and dry parts. Then reassemble for testing.

Compressors treated in this way show a definite reduction in oil consumption. Where compressor is used for operating small tools or instruments, oil in air is objectionable. It's not always possible to remove all oil and entrained moisture in coolers or receivers.

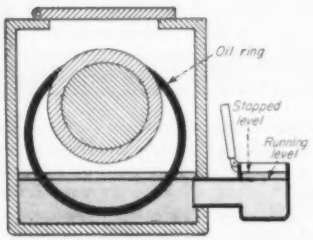
Problem of oil in compressed-air systems is so great that any means of reducing amount of oil carried over into system should be tried.

E F WEHLAGE *Fairport, N. Y.*

How to Improve Screwdriver Grip

WHEN SCREW SLOTS are badly worn, or screwdriver blade keeps slipping in slot, grip can be improved by melting a ball of pitch or rosin. Dip screwdriver blade into this and immediately jam it in screw slot. Rosin or pitch sets at once, holding screw blade firm and improving grip. Rosin can be carried in tool box.

W E WARNER
Woodford Green, Eng.

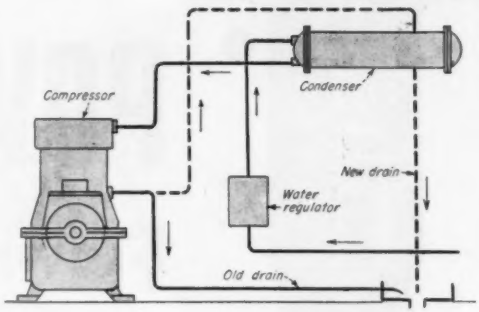


Oil-Level Marks

DO YOU KNOW what level to fill oil-level gage on bearings shown in sketch? Paint two level marks with white or other color oil-proof enamel or paint. on inside surface of oil box. Then add oil whether equipment is rotating or not. There won't be danger of overflowing bearing housings.

Before bearings are drained for periodic flushing, mark oil levels on inside surface of gages with a scriber. Mark at oil level when shaft is rotating, also when standing still. These marks serve as guides when later painting the level marks. STOPPED and RUNNING can also be placed on glass-type oil-level gage. These marks prevent failure.

T TRAIL *Catonsville, Md.*

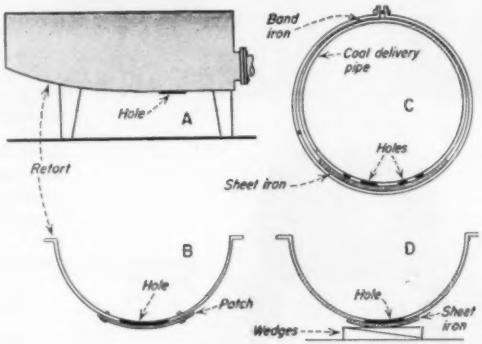


Condenser Tube Trouble Solved Easily

CONDENSER TROUBLE is one of the big plant headaches. We had lots of trouble and finally solved the problem in a simple way. Condenser tubes in this 20-ton refrigerating plant had to be renewed often because of oxidation. This, we finally concluded, was caused by the continual wetting and drying of tubes as unit automatically shut down and started up again. And we were right.

Sketch shows that, each time the unit shut down, the condenser would be drained of water before unit started again. We changed cooling-water drain piping to above the condenser, shown by dotted lines, sketch. Because that kept condenser flooded at all times, our problem was solved. We have had no trouble in two years since change.

GEO MCNALLY *Kearny, N. J.*



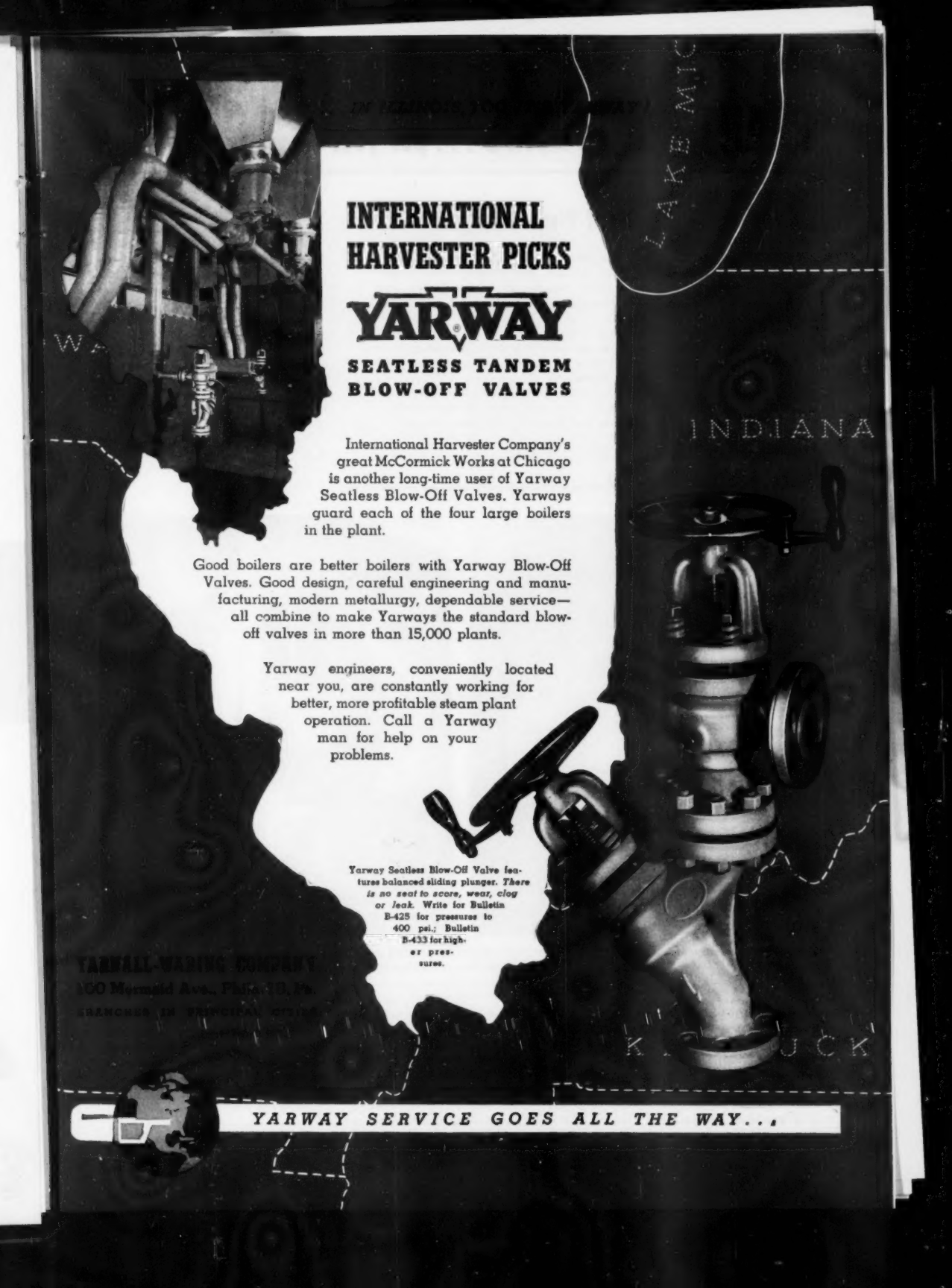
Emergency Repairing of Leak in Retort

FEED SCREW and coal had worn a hole in the bottom of our retort. That caused the windbox to fill with siftings and coked coal. Not having a spare retort, I made a temporary repair. First, I bent a piece of ⅛-in. sheet iron to fit the retort bottom, Fig. *A* and *B*. Then I held this in place with four ¼-in. bolts.

On another job the coal-delivery pipe between the hopper base and retort was worn through several places at the bottom. To repair it temporarily I bent a piece of ⅛-in. sheet iron to fit bottom of pipe. I held this in place with perforated pipe-hanger band iron, Fig. *C*.

Bottom of another hopper base was worn through at a number of points, causing coal to drop through. I made a temporary repair by bending a piece of ⅛-in. sheet iron to fit bottom of base. I held the patch in place with wooden wedges, Fig. *D*, until new one arrived. These repairs keep the job running.

H A JAHNKE *Milwaukee, Wis.*


INTERNATIONAL
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International Harvester Company's great McCormick Works at Chicago is another long-time user of Yarway Seatless Blow-Off Valves. Yarways guard each of the four large boilers in the plant.
Good boilers are better boilers with Yarway Blow-Off Valves. Good design, careful engineering and manufacturing, modern metallurgy, dependable service—all combine to make Yarways the standard blow-off valves in more than 15,000 plants.
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Yarway Seatless Blow-Off Valve features balanced sliding plunger. There is no seat to score, wear, clog or leak. Write for Bulletin B-425 for pressures to 400 psi.; Bulletin B-433 for higher pressures.
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PLANT PROBLEMS... *put your know-how to work*

How Can I Cut Plant Vibration?

HERE ARE THE FACTS: Our power plant serves an industrial plant having a number of hammers, grinders and machine tools. Powerhouse has fans and refrigeration compressors besides boilers and turbines. On roof of manufacturing plant we have a large cooling tower with motor-driven fans.

Our fans and refrigeration compressors have given us trouble ever since they were put in a year ago. Vibration of cooling-tower fans shakes the building. Piping connections to compressor were broken by vibration during operation.

Have *Power* readers ever solved a problem like this after their equipment was installed? What's best way to stop vibration without major changes in foundations and piping?—*IK*, May, *Power*

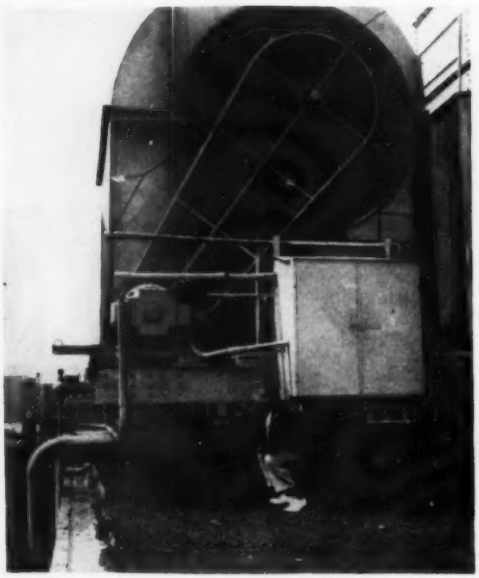
Here Are the Answers

WRONG PITCH in cooling-tower fan blades or blades out of balance could set up vibration. Clean deposits off blades and check tips; they must track each other. After blade is true and balanced, check bearings. Worn bearings or excessive speed cause serious vibration. Use rubber mounts to isolate fan and motor from tower structure.

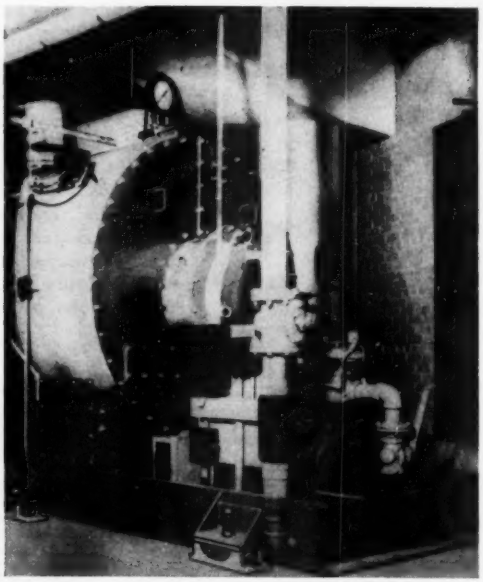
Corrugated stainless-steel or nickel-steel expansion joints in suction and discharge lines protect piping connected to refrigeration compressors. Use spring hangers for supporting pipe that transmits vibration to building structure.

Cork pads for supporting compressor have worked well on many refrigerating compressors. Get maker's advice.

J W SMITHWICK *Washington, D. C.*



STEEL-SPRING vibration isolators support 13-ton fan and motor on building roof. They do a fine job of isolating vibration



PACKAGED BOILER, one of two in this plant atop a 17-story office building, has steel-spring vibration isolator supports

CONSULT MANUFACTURER of industrial vibration-control products when you run into or anticipate problems like *IK*'s. Selection of proper mountings means careful study of machine type, its weight, vibration frequency it creates or must be protected from if it is a precision machine, and type of floor on which machine mounts. Wrong mountings can make vibration worse but the right units cut the trouble at little extra cost.

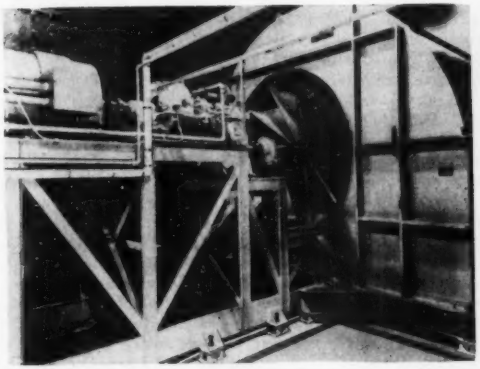
Photos show a number of different applications for vibration-control units. Sometimes piping connected to machines fitted with vibration controls does not need structural saddles to maintain its correct height above floor.

IK can get much help from vibration-control manufacturers. In the long run it is more satisfactory and cheaper to turn your vibration problems over to a specialist, who knows theory and has had years of experience.

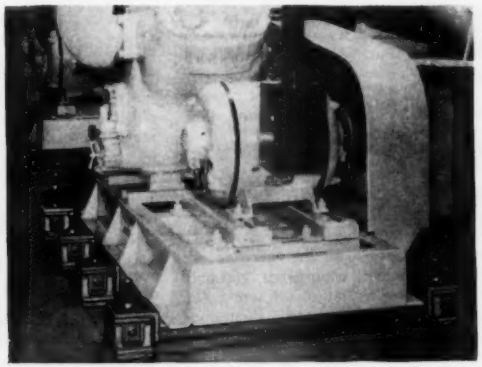
DONALD H. VANCE
Korfund Co., Inc., Long Island City, N. Y.

help the other guy cure his headaches

TYLER HICKS, *Associate Editor*



FAN, 400-HP MOTOR in department store penthouse have steel-spring vibration isolators to prevent transmission of noise



REFRIGERATION COMPRESSORS fitted with steel-spring vibration isolators don't need structural saddles to support piping

VIBRATION-CONTROL units are good on many jobs but they are not the answer if any of these conditions exist:

1. Equipment, particularly with rotating shafts, operated at or near its critical speed has large disturbing forces set up during running.
2. Unbalanced or bent shafts or rotors can cause excessive vibration.
3. Piping that is strained by forcing a fit or joint can exert large forces on a machine casing. The same is true of improperly supported pipes.
4. Overloaded equipment or worn bearings may cause excessive vibration.
5. Weak or unstable foundations can amplify vibration.

IK's smartest move is to first check his equipment for these ills. If he finds any machines that are out of balance he should correct the condition before calling in a vibration-control specialist. Feel free to consult equipment maker.

Don't try to cut vibration with gadgets you build yourself. You may get into trouble. Expert advice and study are needed for best results.

ART CANNON
Laurence Harbor, N. J.

FIND SOURCE of vibration. It may be possible that the refrigerating compressor and fans are causing all the trouble. You can never balance a machine perfectly. So there's always a certain amount of unbalance, which causes disturbing forces that produce vibration.

Steel springs make good mountings for many types of power equipment. Rubber vibration isolators used in shear have the rubber bonded to steel flanges that can be attached to the machine and floor by simple bolted connections. Many sizes for different types of machines are available.

Cork and rubber may be used in compression if loading does not exceed certain values. Don't use either material without the manufacturer's advice. Some rubbers must not be subjected to temperatures above 120 F.

My experience around big plants shows that (1) rubber vibration isolators are good where there's plenty of space around machine (2) steel springs are excellent for tight jobs (3) rubber mats are OK except in high-temperature areas, and (4) cork mat is fine where its recommended loading is not exceeded.

A. J. BREUGELMANS
New York, N. Y.

UNBALANCED FANS in cooling tower may cause *IK's* roof vibration. Check with a vibration indicator or slightly loosen fan supporting bolts and watch fan movement as unit is started.

Stop compressor piping vibration by fitting an expansion bend near the compressor. Anchor one end of bend securely. Pipe fabricators and builders of vibration isolators will be glad to help with these problems.

IRA A BUTCHER *Cincinnati, O.*

REFRIGERANT PIPING vibration can be stopped in a number of ways. If pipe sways, use sway braces fitted with springs. These limit sways or "rocks" in *IK's* piping to a maximum of 1/64 in.

If vibration is reed-like, varying the hanger spacing in prime lengths—11, 13 or 17 ft lengths, for example—prevents adjacent sections from picking up vibrations. But don't change hanger location or put in new hangers until you've consulted a vibration specialist and received his approval.

Cooling tower probably transmits forced vibrations to building structure. *IK* can stop them with spring or rubber isolators. Many vibration-equipment manufacturers will design the whole isolating system for him, if he wants it.

H A KANNIANEN *St. Albans, W. Va.*

SPRUNG SHAFTS, improperly placed balance weights, dirty fan blades or turbine buckets, unequal settling of foundations, loose bedplates, and internal rubbing are only a few causes of vibration. Look for these in your machines. You may find more troubles than you every thought existed.

C A WILKES *Oaklyn, N. J.*

STEEL-COIL spring isolators are *IK's* most economical solution. Cork or rubber are good too, for certain jobs. Don't try to pick isolators without advice from manufacturer.

Steel springs can be adapted to many installations since their dampening qualities can be accurately predetermined. Once installed, they are easily altered without changing foundation.

(*Continued on page* 132)

More PLANT PROBLEMS

Begins on page 130

Don't rigidly bolt vibrating machines to foundations that transmit noise. Reinforced concrete is the most efficient foundation from a noise standpoint. Wood is a troublemaker. Don't locate heavy vibrating machines close to building walls or columns.

Flexible metal hoses are low cost and excellent for preventing machine vibration from damaging connected piping.

L FITZPATRICK *Jefferson City, Mo.*

OLD TRICK STILL WORKS. Stand a penny on its edge on each machine while it runs. If penny doesn't fall off, the vibration isolators on the machine are OK. Remember, compressor vibration can be caused by not enough foundation volume, short piping with right-angle bends or different rpm of a number of machines close together. Pulsating effect of compressor discharge is a big trouble maker and in time can ruin a walled structure.

By bolting pipes rigidly to steel beams or heavy reinforced concrete anchors, *IK* can stop much vibration.

If cooling-tower supporting members are not rigid enough, *IK* may have to put in additional I-beams. Don't do this without the advice of a structural engineer. In one large plant we found that fitting expansion joints in water lines to and from tower cut vibration considerably. Condenser no longer received vibrations from tower.

JOHN M GORRIE *Richmond, Va.*

WOOL PADS of the patented type do a good job of isolating vibration. They are installed under the equipment giving trouble. Recently we installed pads of this type on a hospital cooling tower. With these and flexible piping connections the vibration was eliminated.

P N WHEELER
The Felters Co., Boston, Mass.

HERE'S HOW to make a simple check to find machine that vibrates. Stop all machines and place a bowl of water on the floor near the unit that is thought to be giving trouble. Start the machines one by one. By watching the ripples on the water you can find the machine or combination of machines that cause excessive vibration.

Often only one machine may cause all the trouble. Or vibration may be transmitted from shell of building by pipes and conduit. Rubber and cork are good isolators but oil affects both.

W E WARNER *Essex, England*

What Makes Diesel Shift Its Loads?

HERE ARE THE FACTS: Our diesel plant has two 300-kw units that run at 360 rpm, and one 700-kw unit that turns at 257 rpm. Recently our load increased, so we buy current from utility and run the diesels in parallel with it.

When we run the 700-kw unit in parallel with utility lines there is a continuous load shift between engine and line of about 80 kw. Pulsations are at a rate of about 120 per min. This causes trouble on television and X-ray units.

We tried changing governor setting and also put on a new governor but had no luck. What causes this trouble? How can we stop it? Why does it happen only on 700-kw unit?—*CM*, May, *Power*

Here Are the Answers

SLUGGISH GOVERNOR causes *CM's* trouble. When a diesel has a defective governor it often fluctuates between overloaded and light-load conditions. Have an engineer from governor firm check the unit.

W E WARNER *Essex, England*

LIGHT FLYWHEEL may be giving *CM* trouble. Or governor may not be sensitive enough. I'd check the WR² of flywheel on each unit and see that it is the same as manufacturer recommends. Slower speed of larger unit allows more time for speed reduction between power strokes. Since voltage drops when speed does, a sensitive voltmeter would be helpful in steadying the engine.

IRA A BUTCHER *Cincinnati, O.*

CHECK ENGINE with good exhaust pyrometer to see that each cylinder carries equal load. If they do, check to see that compression pressure is the same in all cylinders. If it is possible to equalize firing pressure, do so by changing injection timing.

Take play out of governor linkage to fuel pumps. *CM* will always have a certain amount of pulsation, depending on number of cylinders and weight of engine flywheel.

BRUCE W BRYAN *Fresnillo, Mex.*

MATCH SPEED DROOP of engine to characteristics of utility-line generators, if possible. Then plant load is better distributed whenever a lasting change occurs in over-all load.

Some governors tend to "hog" entire load changes. Load division in these governors doesn't depend so much on speed droop as on governor response and sensitivity. The 700-kw diesel unit may have a faster-acting governor than the utility prime mover and tend to take more than its right share of load, causing the swings.

See an electrical engineer for advice on the best type of load regulator for your plant. Several types will help.

L FITZPATRICK *Jefferson City, Mo.*

VALVE ADJUSTMENT or timing of 700-kw unit may be out. Or load of this engine may have to be limited to a certain value to prevent swings.

C O VON DANNENBERG
Brooklyn, N.Y.

NEW UNIT has 28 poles and at 257 rpm runs at 59.966 cps. Increase engine speed slightly to bring output up to 60 cps. Check with manufacturer if trouble continues.

N M TURITZIN *Brooklyn, N.Y.*

UNBALANCED FIRING that causes a speed change gets *CM* in trouble. Easiest way to cure is to adjust for equal firing pressures in each cylinder.

E A ROBERTS *Carlsbad, N. M.*

(*Conitnued on page* 134)

RESEARCH AND USE PROVED QUALITY OF SUN ELECTRICAL OILS

Constant research has enabled Sun to keep pace with the ever-changing requirements of the fast-moving electrical industry. Used for years by leading manufacturers of cables, capacitors and transformers, Sun Electrical Oils have been "Job Proved" under actual operating conditions. This combination of laboratory research and field experience assures you of completely dependable products that satisfy the most rigid electrical requirements.

SUN CABLE AND CAPACITOR OILS...

1. LOW POWER FACTOR—assures minimum current loss because of high insulating value of oil.

2. HIGH DIELECTRIC STRENGTH—due to freedom from solid impurities and moisture.

3. HIGH RESISTANCE TO OXIDATION—due to choice of crude stocks and method of refining, Sun Electrical Oils have high stability, and as a result, oxidation is minimized.

4. LOW POUR POINT—an inherent quality that assures fluidity under most operating conditions.

5. FREEDOM FROM CORROSIVE ACIDS AND CORROSIVE SULFUR—helps prevent deterioration of cable materials.

SUN TRANSFORMER OILS...

1. EXCEPTIONAL HEAT TRANSFER ABILITY—eliminates heat build-up.

2. HIGH DIELECTRIC STRENGTH—due to complete freedom from solid and liquid impurities.

3. FREEDOM FROM CORROSIVE ACIDS AND CORROSIVE SULFUR—helps prevent deterioration of transformer components.

4. HIGH RESISTANCE TO OXIDATION—because Sun Electrical Oils, as produced, are free of impurities and possess high degree of stability, oxidation is minimized throughout their life.

5. INHERENT LOW POUR POINT—assures fluidity under most operating conditions.

WRITE FOR COMPLETE INFORMATION

Just fill in the coupon. We'll be glad to send literature or have a Sun representative study your problem.

SUN OIL COMPANY, Dept. P-8, Philadelphia 3, Pa.

☐ I would like more information about Sun Cable and Capacitor Oils.

☐ I would like more information about Sun Transformer Oils.

☐ Please have a Sun representative call on me.

Name_____

Title_____

Company_____

Street_____

City_____ Zone_____ State_____

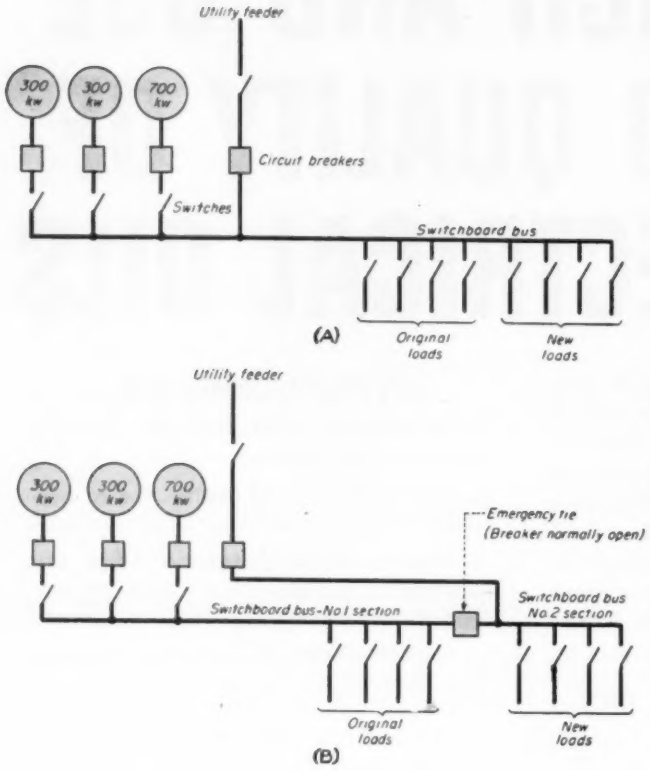
SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

More PLANT PROBLEMS

Begins on page 130



DIESEL TORQUE varies during each stroke. With steam or water turbines, torque is constant. Assuming *CM* hooks into 60-cps utility lines, his trouble is caused by the heavy changing currents, which distort wave shape and produce a series of ripples that interfere with television and X-ray machines.

These effects might be more pronounced with slow-speed engines but *CM's* load shift might also be from (1) a sluggish governor (2) retarded voltage-regulator response and (3) a swing-load condition on either utility or plant lines.

With *CM's* mismatched prime movers, both purchased power and diesel fuel costs will be high. One correction for his problem is separation of the switchboard bus into two parts as in the sketches.

Sketch *A* presumes that the three diesels and the utility feeder tie into a common switchboard bus from which all plant distribution circuits take off. Sketch *B* shows how the bus is broken to separate the generators from the utility feeder. One bus section carries all loads up to and including maximum capacity of the generators. Other bus section handles all loads in excess of plant capacity. Emergency tie breaker is also used for trimmed load operation in utility feeder failure.

While my correction is simple I think *CM* should consult an engineer.

J. C. FERRANTE *New York, N. Y.*

YOUR NEW PROBLEMS

1 Best Place for Evaporator in Cycle

Our engineering department plans some central-station plants. Often we get into discussions about the best place for an evaporator in the plant cycle.

Of course, we realize that much depends on plant heat balance, but from what we've seen some choices open to designers are: (1) evaporator and deaerator supplied bleed steam at same pressure (2) evaporator fed bleed steam at lower pressure than deaerator (3) evaporator bleed steam pressure higher than deaerator and (4) deaerator acting as evaporator condenser.

What we'd like to know is how these various hookups compare from thermal and cost standpoints. We make an analysis for each plant we design and come to a definite decision before selecting a particular hookup. But so many intangibles pop up in our talks that I've been wondering what other *Power* readers use to guide their thinking. Hookup sketches to help our plans will also be appreciated—*LF*

2 How Can We Dry Air For Instruments?

Our plant has many air-operated instruments and controls. Air pressure needed for most of these units is 175 psi. The air must be dry or we run into trouble.

Last winter moisture froze in some of our outdoor lines, fouling up the works. So this summer we want to do something to prevent another freeze.

What's best way to remove moisture from instrument air? Our instrument air compressor is rated at 100 cfm. One engineer has suggested we use refrigeration to cool air and remove its moisture. Another thinks the batch method of adsorption drying is better.

We haven't had much experience with either method and would like to know what results *Power* readers have had with them. We like refrigeration because it is continuous but adsorption using a desiccant in two towers can also be made a continuous process. How do the two methods stack up in installation, maintenance and cost?—MJ

Will you help readers who sent us problems? Extra pay for photo or sketches.

Modern power plant practice demands a water conditioning program that produces only the ultimate in trouble-free and efficient boiler operation.

External softening and the use of conventional inorganic treatments are recognized requisites. However, the supplementary use of organic agents may well assure the difference between long, uninterrupted operation and frequent boiler outages due to scale and sludge formations.

Take the case, for example, of a large electrical manufacturer, who called in Betz 14 years ago to treat its new power plant. This plant operates at 900 pounds pressure with 50% make-up polluted river water. Betz recommended the use of organic agents to supplement the external softening and inorganic treatment.

Here are the results from the record: In the entire 14 years operation of these boilers, they have never been turbined or acid cleaned and no difficulties from feedwater conditions have occurred! What's more, excellent steam purity is produced and turbine blading is completely clean.

This plant could easily be your plant—operating efficiently, free from frequent boiler outages through the effective use of Betz *Specialized* Water Conditioning Service. Why not call on Betz today for an interesting discussion of your water problems? There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

Send today for Betz Technical Paper No. 98, "Boiler Scale—Its Formation and Prevention." It's free.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers

Marmy's Been Framed Again

As ONE OF Marmaduke Surfaceblow's most ardent admirers, I keep his personally autographed photo on my desk. Needless to say, it gets a lot of comment from power engineers who drop in on business. (Marmaduke is the one in the frame . . . I'm sitting at the desk.)

After working with boilers for only 30 years, I find Marmaduke's stories a constant inspiration to us youngsters (compared to his 90 odd years).

He does make rash statements at times, though, that lead me and my fellow boiler inspectors to believe that he should cut down on that Sandpaper Gin. I don't want to spoil his pleasure; I'm just anxious for the old boy to keep sounding off for many years to come. Yours for more stories.

DON KINCAID *St. Louis, Mo.*

Supercautious over Chromates

WE READ WITH INTEREST the article "Chase Rust from Air-Conditioning Units" (p 128, May POWER) and are glad to see you emphasized the importance of corrosion control in this type equipment.

The stand of the Meat Inspection Division, Bureau of Animal Industry, U. S. Department of Agriculture is an interesting one. Actually, they have informed us several times that they have no formal regulations pertaining to the use of chromates in air-conditioning systems in meat-handling plants. They will not, however, approve the operation of an air-conditioning system making use of chromates or other non-potable chemicals in food-handling plants.

We feel that the Department of Agriculture is being supercautious in this. In closed piping, the only opportunity for treated water to come into contact with the food would be in a break in the line. The same hazard exists with ammonia lines. With air washers, there is a theoretical chance that some chromate-containing spray might be carried through the eliminators into a food-handling area. Numerous tests, however, indicate that this does not happen, as shown, for example, in the work of the American Society of Heating and Ventilating Engineers, Research Technical Advisory Committee on Corrosion (reported by W Z Friend on page 187, March 1942, ASHVE Journal).

We go along wholeheartedly with the POWER article's advice to call in a water specialist before using any of the scale-control methods and, in fact, believe that same advice should be extended to include corrosion-control methods as well.

S SUSSMAN *Chief Chemist*
Water Service Laboratories, Inc.

Peaches, Grapes & Aspirin

EVERYTHING MAY BE peaches down in Georgia, but B D Riley's letter was sour grapes (p 125, June POWER). Riley suggests that H A Jahnke have his head X-rayed for loose nuts and bolts (maybe we all should). But I personally think it would be much more interesting if one of your photographers could take a picture of Riley in the act of getting in or out of a boiler drum from the top of a ladder by the method he advises, "Put one leg in first, then head and shoulders." It would either make the funniest picture I ever saw or assure Mr. Riley of a fat television contract. They say contortionists are in great demand in the TV field.

The question, "Should you get in or out of a boiler head or feet first?" is akin to the concave-convex tank problem. It depends more or less on the individual and the circumstances. For instance, to get into an upper drum, which has its manholes at the ends, you may have to do so from a ladder or a platform which is a few feet below the manhole. In this case, you normally go in head first and come out feet first.

On the other hand, if manholes are located on top (as in most firetube boilers, etc), you naturally get in feet first and come out head first. How in the world can you enter or leave a 15x11-in. manhole by putting one foot in, then your head and shoulders, is beyond my simple mind. Then again, perhaps they make manholes different down in Georgia.

As for the individual, a 200-lb man will enter with caution, while a small, supple fellow would go in and out like a jack rabbit. I wonder if Riley ever chipped scale in a ship's bilge tanks? It's the best experience I know of to learn how to crawl (or fly) through manholes. I did it at the age of 14 . . . couldn't now though.

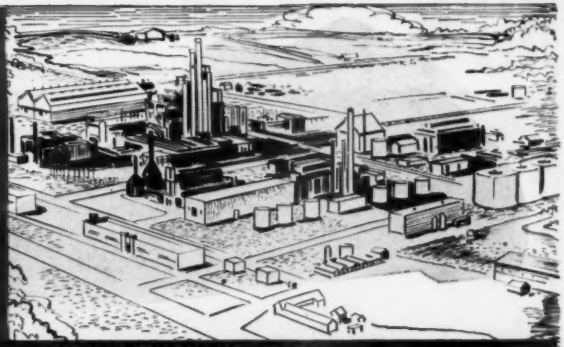
A CANNON *Laurence Harbor, N.J.*

People are Furnaces

A PERSON JUST SITTING in a chair gives off 400 Btu per hr. If he's getting a real physical workout such as dancing or swinging a sledge, he gives off 750 Btu per hr . . . in some cases as much as 1000 Btu per hr. The air in a theater holding 1000 people will be heated with 400,000 Btu every hour . . . and well above that if the movie's a comedy and everyone's laughing.

G K PAYNE *Dallas, Texas*

A STEAM TRAP CASTS A MIGHTY BIG SHADOW!



THINGS STEAM TRAPS AFFECT	REASON	HOW ARMSTRONG TRAPS MEET THE NEED	EXAMPLE
1 HEAT-UP OR START-UP-TIME	When steam is turned on, large amounts of condensate and air must be removed.	Condensate and air are discharged as fast as they reach trap.	*40 Minutes Faster Heat-up* of drying oven at pharmaceutical plant with Armstrong "Blast" traps.
2 RATE OF PRODUCTION	Quick heat-up, maximum temperatures essential for maximum output.	Air and condensate discharged at steam temperature; equipment kept full of hot, dry steam.	*30% Greater Output* from jacketed kettles at Canadian plant since changing to Armstrong traps.
3 STEAM WASTE	When steam gets past traps, fuel is wasted, boiler capacity may be inadequate.	No steam ever reaches discharge orifice, even when there is no condensate load. Heat treated chrome steel valve parts, ground and lapped, resist wear, stay leak-tight for a long time.	*Steam Savings Eliminate Need for New Boiler* at chemical plant since installing Armstrong traps.
4 FUEL WASTE	Steam that blows through traps does no useful work, wastes fuel.		*33⅓% Reduction in Fuel Bill* after trapping vats with Armstrongs at Missouri plant.
5 CONTINUITY OF OPERATION	When traps are inoperative or down for repairs, unit being drained may be "off the line."	Nothing to clog, stick or collapse! Large orifice. Self-scrubbing action cleans out dirt, scale. "Frictionless" leverage, heavily reinforced. Wear and corrosion-resistant stainless trim.	*Maintenance Time Cut* 30% Illinois user says, "Unequalled dependability, simplicity of design means repairs can be made quickly" (with minimum equipment downtime).
6 MAINTENANCE COST	Traps that don't "wear well" take a lot of manhours for repair.		

BIG effects from little traps! And, the effects are multiplied by the number of traps in the plant you design or operate until they grow to be a major influence upon operating efficiency and economy.

Before you specify steam traps ask your nearby Armstrong Representative to call. He is qualified to give you practical assistance and answers that can save you a lot of time and trouble.

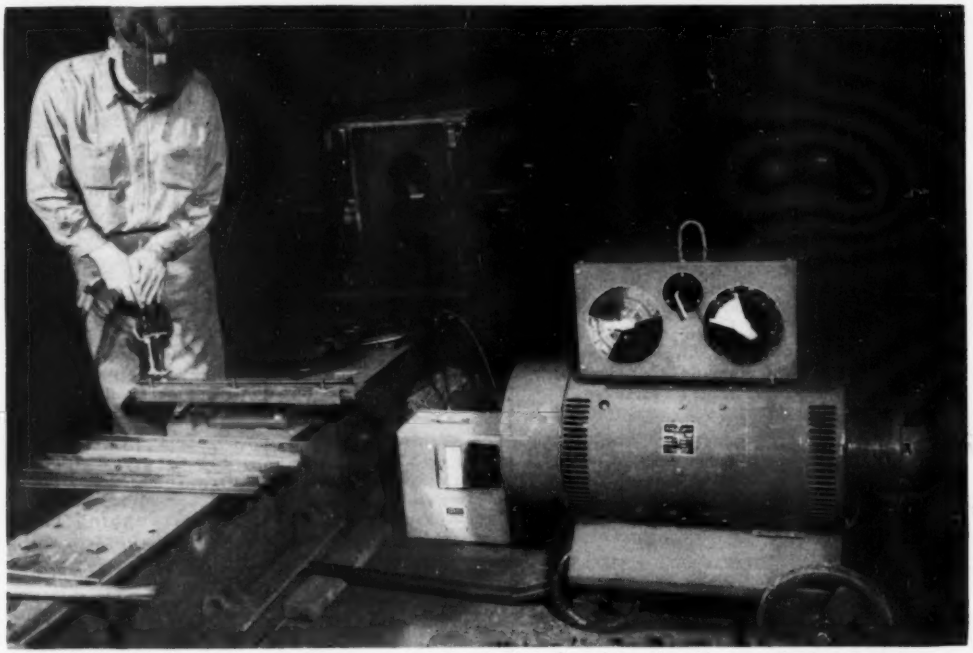
SEND FOR CATALOG

The 44-page Armstrong Steam Trap Book gives complete data on trap operation, selection, installation, maintenance, safety factors, etc. Free on request . . . Write:

ARMSTRONG MACHINE WORKS • 812 Maple St., Three Rivers, Mich.

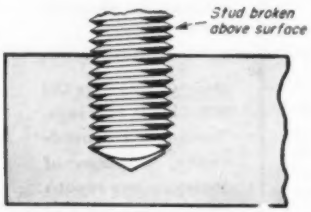
ARMSTRONG STEAM TRAPS

HOW TO END-WELD BROKEN STUDS

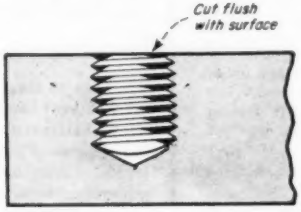


END-WELDING STUDS with this special generator saves costly time. Gun also works with conventional equipment

If Stud Breaks Off Above the Surface



ABOVE-SURFACE breaks are often too low to remove stud with pipe wrench.



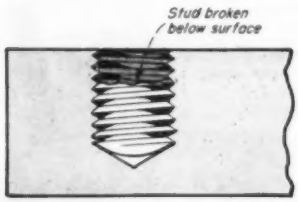
FIRST STEP before welding is to cut the broken end flush with a cutting torch

Replacing broken studs is the maintenance man's bugaboo. Whether stud breaks off above or below surface, he must remove broken portion, retap hole, and screw in a new stud.

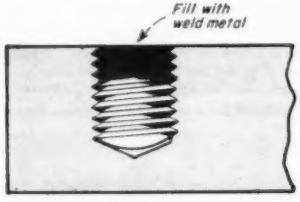
With this stud welding gun, it's a simple job. There's no drilling or tapping—stud is simply end-welded in place after minor surface preparation. One plant has cut bolt replacement time from 20 min to five by this method. Weld joint is stronger than metal. Lightweight, portable gun makes job easy, regardless of location.

Courtesy, Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio

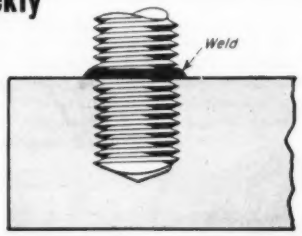
Or Below the Surface...The Stud Is End-Welded Quickly



BELOW SURFACE break is tough because stud is often frozen and won't back out



FLUSH HOLE with surface by filling it in with weld metal for base of new stud



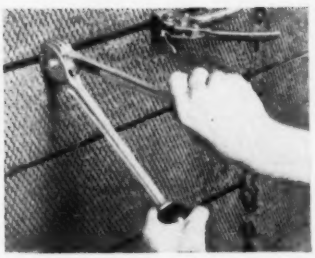
WELD NEW STUD directly over broken one. Weld is stronger than metal in stud

EAGLE PICHER Insulations

Carefully designed to fit your needs, to save you time, power, money

SUPERTEMP BLOCKS

These are efficient insulating blocks manufactured from Eagle-Picher High Temperature Mineral Wool. They derive low thermal conductivity, high refractory value, and outstanding chemical and physical stability from this basic insulating material. Weight is approx. 22 to 24 lbs. per cu. ft. Designed for temperatures up to 1700 F.

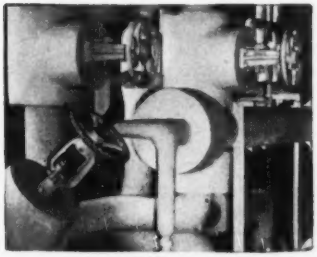


MINERAL WOOL BLANKETS

The answer to the problem of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Factory-made, these blankets are *certified* to meet rigid high standard specifications, offer unexcelled uniformity of mineral wool distribution. Withstand continuous exposure to temperatures as high as 1200 F. . . . offer maximum water repellence . . . resistance to steam, corrosive fumes, normal vibration.

SUPER "66" INSULATING CEMENT

A rust-inhibitive, super-adhesive insulating cement . . . offers exceptional coverage, extreme thermal efficiency. "Springy ball" structure—with small resilient pellets, each containing thousands of "dead" air cells—provides one of the most effective heat barriers known. Easily trowelled over all kinds of surfaces. Efficient up to 1800 F. . . . reclaimable where temperatures don't exceed 1200 F. Can be applied to any heated equipment.



ONE-COTE CEMENT

One-Cote provides both insulation and a smooth off-white finish coat. Unexcelled for coverage —100 lbs. covers approx. 40 sq. ft. one inch thick—Eagle-Picher One-Cote Cement is of uniformly high quality . . . quick setting, easy to handle . . . can be painted. This self-protected insulation withstands temperatures up to 1000 F.

MAXIMUM FUEL SAVINGS AND EXACT TEMPERATURE CONTROL WITH THESE EAGLE-PICHER INSULATIONS:

• Insulating Felts • Supertemp Block • Blankets • Loose Wool • Pipe Covering • Stalastic • Stamastic • Insulseal • Finishing Cements • Insulating Cements • Fireproofing Cement • Swetchek • Diatomaceous Earth Block.

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY *Since 1843*

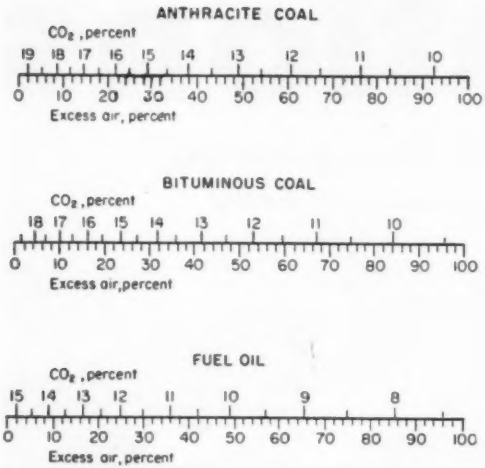
GENERAL OFFICES: CINCINNATI (1), OHIO

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

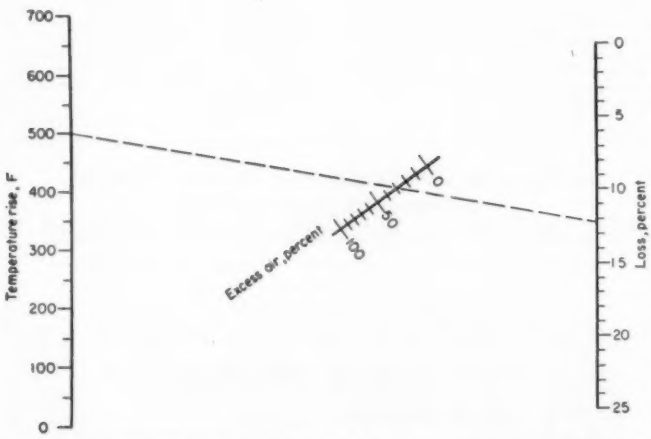
HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

Easy Way to Figure Heat Loss up Stack



FOR ANY VALUES of CO_2, scales above give you the corresponding values of percentage of excess air that's involved



FOR HARD AND SOFT COAL, and for fuel oil, this chart gives percentages of fuel's heat wasted in hot flue gas. Dotted line shows how to use for 500-F temperature rise and 30% excess air. Right scale shows the flue loss is 12.2% of fuel's heat

—FOR SEVERAL MONTHS NOW we have discussed combustion from the angle of gas chemistry to make clear just why the CO_2 percentage in the flue gas measures the excess air supplied to the fire. Now the time has come to give this a practical application after recalling a few main points we have learned.

Here are these points: First, the CO_2 analysis does *not* show whether combustion is complete. What low CO_2 really shows is that the fixed volume of CO_2 produced by burning a ton of coal is heavily diluted with useless excess air. This is a big waste, because it goes up the stack hot, "heating up the sky."

Now a given CO_2 analysis means one percentage of excess air when burning anthracite, less for bituminous and still less for fuel oil. For 12% CO_2, charts at top, left, show 61% excess air for anthracite coal, 53% for bituminous and 24% for fuel oil.

The actual stack loss in the hot gases depends on both the excess air and the stack temperature. Here's a practical example: *What is the percentage stack loss in hot gases for a bituminous coal if the stack-gas temperature is 580 F, the room temperature 80 F, and the CO_2 in flue gas 14.2%?*

The scale for bituminous coal shows that the excess air is 30%. Temperature rise is stack temperature, minus room temperature, or 580 F — 80 F = 500 F.

Now it's easy to figure the loss from the bottom chart. As shown by the dotted line, run a straight edge from 500 on left scale through 30 on center scale. It cuts right scale at 12.2%. This means that 12.2% of the coal's heat is wasted in "heating up the sky."

ALL FORGED STEEL

Edward

INSTRUMENT VALVES

Lowest Cost Valves for Their Rating!

Standardize on Edward instrument valves—forged steel, yet their price is comparable to ordinary bar-stock valves.

Edward instrument valves are top-quality in every design detail—easy-grip T-handle . . . bronze yoke bushing . . . forged steel one-piece outside screw yoke . . . forged steel corrosion-resistant EValized packing gland . . . EValloy 13% chromium stainless steel stem-disk with needle point for close flow control . . . forged steel EValized gland bolts that swing out of the way for easy repacking . . . heat resistant die molded EValpak packing.

And look at this versatility—

★ STEAM, WATER, OIL or GAS PRODUCT PROCESS LINES

Edward instrument valves fit into any piping system. Globe or angle, sizes ⅛", ¼", ½", ¾" and 1".

★ HIGH TEMPERATURES or HIGH PRESSURES

Rated up to 6000 lb at atmospheric temperatures, or up to 1500 lb at 1000 F.

★ STANDARD or CORROSIVE SERVICE

Available in carbon steel or 13% chromium bodies and trim.

★ TYPICAL USES

Orifice Meters	Regulators
Instrument Panels	Gage Lines
Oil Field Xmas Trees	Drip and Drain Lines
Hydraulic Systems	Pressure Recorders
Vent Lines	Corrosive Lines

Get the full story on Edward instrument valves—*the lowest cost valves for their rating.* Write for Bulletin 491.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

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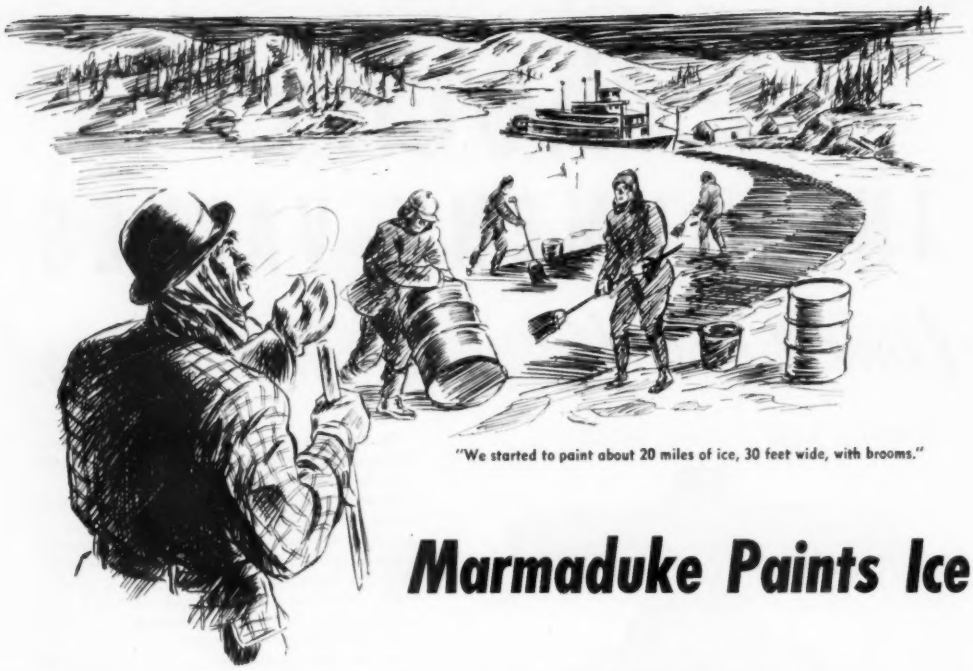
Another Product



"We started to paint about 20 miles of ice, 30 feet wide, with brooms."

Marmaduke Paints Ice

► LAST WEEK when that unpredictable consulting engineer, Marmaduke Surfaceblow, dropped into our office (to get a small loan) he saw the stack of engineering magazines that float across an editor's desk.

Thumbing through an English journal, he read a brief account of a new theory that has caused some argument.

"BILGEWATER ON THEORIES," he suddenly roared, slapping down the magazine on a desk. "They're no good if you don't harness them for practical use."

He had the floor, so we listened. Here's his story.

"Back in the summer of 1925 I was headed for Skagway, Alaska, as deck engineer of the SS *Alaska Queen*. At Klondike Harry's Bar in Skagway, I ran into two American prospectors who had been panning at Livingston Creek. They were dead broke but said they were hot on the trail of a big find. And all they needed was a grubstake to go back and strike it rich. After I blew them to a dozen drinks, they agreed to take me in as a partner—if I put up the dough. So next day I packed my sea bag, piled off the *Queen*, and headed for the Yukon, with my new partners.

"After five weeks of panning and chasing sea-gull-sized mosquitoes, we had used up our grubstake and were dead broke. An old-timer did find a $700 nugget a mile up the creek, but we didn't pan enough of a poke out of all that work to wet our whistles with a bottle of Sandpaper Gin. So I dissolved my share of the partnership and shoved off.

"I made my way to the Yukon River and landed at Dawson City. As luck would have it, the river steamer *Casca* needed a chief engineer. She was a stern-wheeler, about 140 feet long and 26 feet wide. Her two horizontal engines had 16-inch cylinders of 72-inch stroke. With 200 pounds of steam, the engines developed about 420 horsepower. In her boilers, we burned four-foot-long cordwood, picked up from natives along the river.

"The *Casca* carried 90 passengers and about 100 tons of general freight. Besides that, she shoved a barge ahead, loaded down with another 175 tons. Returning upstream, she hauled tons of silver-lead ore and concentrates from Mayo, on the Stewart River.

"Shipping lasted only from May 25th to October 6th that year. Rest of the year the Yukon was frozen over solid. But the *White Pass & Yukon Route* people were mighty nice. They asked me to stick around and overhaul the *Casca's* boilers and engines that winter. I decided to stay and settled down in the lively frontier town of Whitehorse.

"Whitehorse was the distributing point for all supplies to points north of the Yukon Territory. Supplies included almost everything the inhabitants needed. Even fresh meat was received in refrigeration from Vancouver, British Columbia.

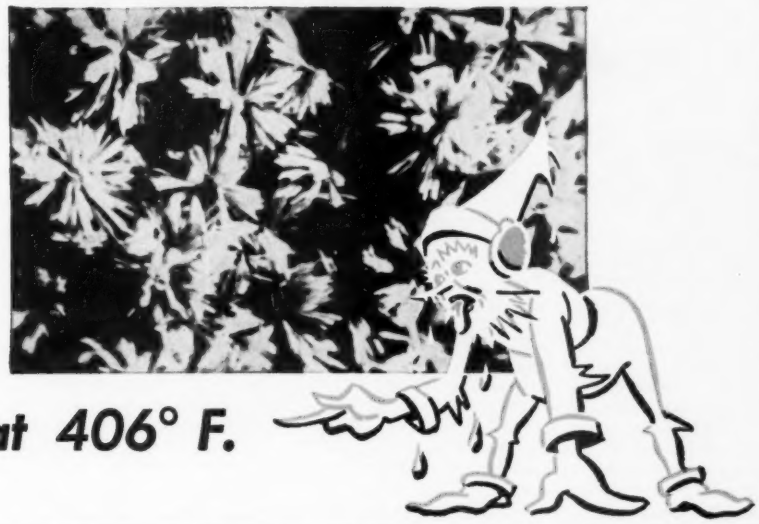
"One reason for the short shipping season was Lake LeBarge. She was a bottleneck in early winter and early spring. It was about that lake that Robert Service wrote in his 'Cremation of Sam McGee':

. . . Till I came to the marge of Lake LeBarge and a derelict there lay;
It was jammed in the ice, but I saw in a trice it was called the *Alice May*.
And I looked at it and I thought a bit, I looked at my frozen chum;
Then 'Here,' said I, with a sudden cry, 'is my cre-ma-tor-eum.'
Some planks I tore from the cabin floor, and I lit the boiler fire;
Some coal I found was lying around, and I heaped the fuel higher.
The flames just soared, and the furnace roared—such a blaze you seldom see;
And I burrowed a hole in the glowing coal.
and I stuffed in Sam McGee. . . .

"Lake LeBarge is 25 miles long and is a section of the Yukon River, about 25

(*Continued on page* 202)

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

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"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

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THE Nalco SYSTEM...Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS 63

How to plan

PIPING CONNECTIONS FOR A DIESEL ENGINE LUBRICATION OIL PURIFICATION SYSTEM

In diesel engine service, a purification system for lubrication oil is a double economy. It reduces lubrication costs, by prolonging the life of the oil. It also decreases maintenance costs of the diesel engine by keeping wear to a minimum, and permitting longer periods between inspections. Practically all modern stationary or marine diesel engines use some type of lube-oil purification system.

The main purpose of a purification system is the removal of all impurities picked up in the engine. This must be accomplished without removing the oil additives that are used to increase the efficiency of the lubricant and preserve engine bearing surfaces.

Solid particles which come in from the air and fuel oil, suspended carbon and colloidal carbon, as well as water, which result from combustion of the diesel fuel oil, get into the lube-oil and must be removed in order to prevent frequent breakdowns.

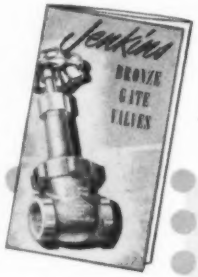
As the accompanying diagram shows, circulated oil from the engine is returned to a tank. Part or all of this oil is pumped through a thermostatically controlled heater where the oil is raised to about 130°F., the optimum cleaning temperature. The oil enters a continuous centrifuge where water and solid impurities heavier than the lube-oil are removed and drained. The partially cleaned oil then passes through the filters where light impurities and colloidal carbon are removed, and then on to the clean oil storage tank for re-use in the diesel.

In normal operation of the diesel, the engine lube-oil pump draws oil from the clean oil tank and pumps it through a cooler which is generally a shell and tube heat exchanger with water used as the coolant. The cooler reduces the oil temperature raised during purification.

Some installations, like the one illustrated, employ an auxiliary lube-oil pump which is placed in operation prior to starting the engine, and guarantees that sufficient oil is pumped to all bearing surfaces before the diesel is in operation. Once the diesel has attained speed, the engine pump takes over.

Jenkins Fig. 270-U Bronze Gate Valves are recommended for lube-oil cooler, oil heater, water discharge, and condensate shutoff service in this hookup. Monel metal seat rings, and exceptionally rugged construction reduce wear, make this one of the longest-lasting, lowest-upkeep valves money can buy. Fig. 270-U, together with 35 other Jenkins Bronze gates for all types of service, is described in the folder below, Form 181-A. *Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.*

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors everywhere.



SEND FOR THIS FOLDER
It illustrates and describes the complete line of Jenkins Gate Valves, which includes 30 different patterns for various service conditions. Fill out and mail the coupon today.

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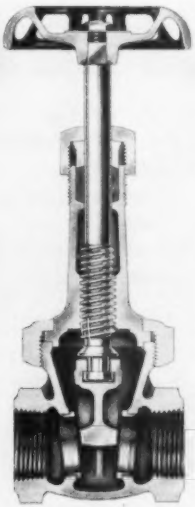
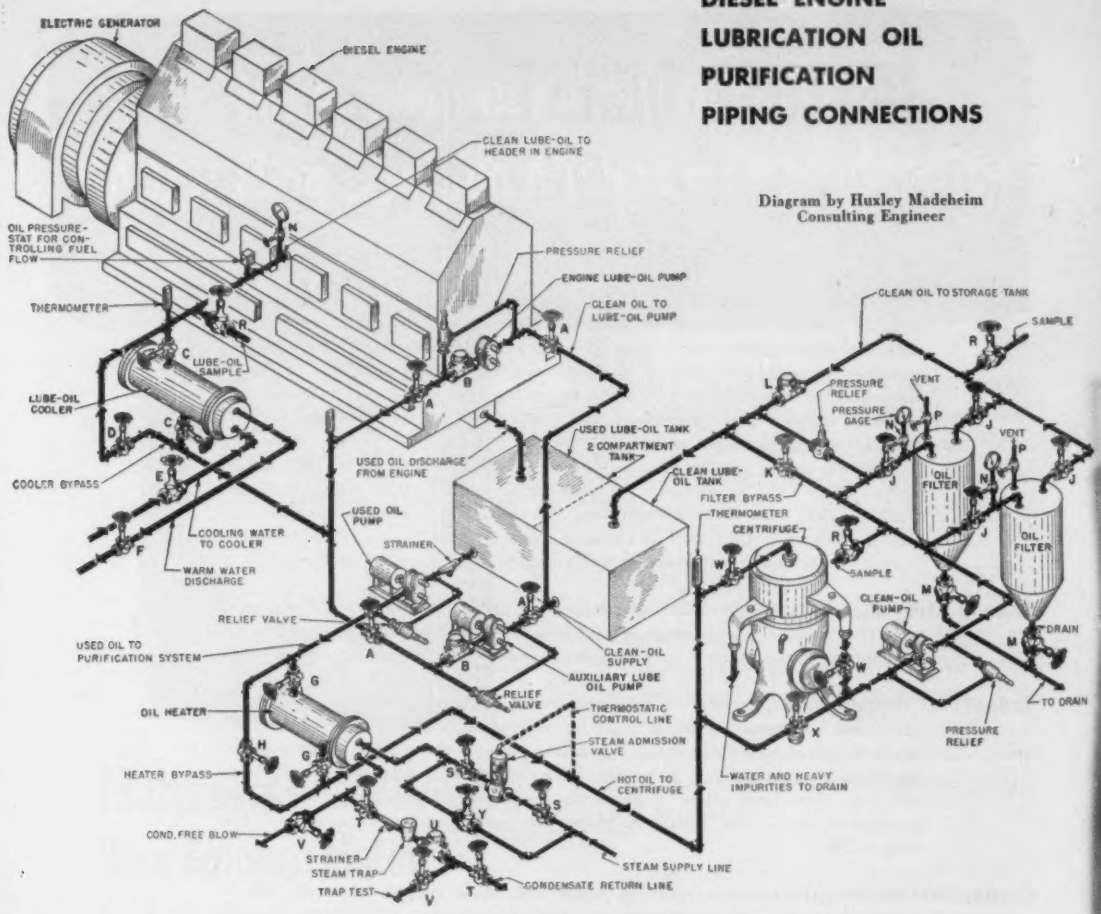


Fig. 270-U
Solid Wedge
Inside Screw
Traveling Spindle
Union Bonnet
BRONZE
GATE VALVE
200 lbs. Steam
400 lbs. O.W.G.

DIESEL ENGINE LUBRICATION OIL PURIFICATION PIPING CONNECTIONS

Diagram by Huxley Madeheim
Consulting Engineer



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VALVE RECOMMENDATIONS

For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Jenkins Valve	Service
A	4	Fig. 270-U Bronze Gate	Oil Supply to Engine Lube System
B	2	Fig. 762 Br. Swing Check	Prevent Reverse Flow
C	2	Fig. 270-U Bronze Gate	Lube Oil Cooler Shutoff
D	1	Fig. 270-U Bronze Gate	Lube Oil Cooler Manual Bypass
E	1	Fig. 950 Bronze Globe	Cool Water Supply to Lube Oil Cooler
F	1	Fig. 270-U Bronze Gate	Water Discharge Shutoff
G	2	Fig. 270-U Bronze Gate	Oil Heater Shutoff
H	1	Fig. 270-U Bronze Gate	Oil Heater Manual Bypass
J	4	Fig. 270-U Bronze Gate	Oil Filter Shutoffs
K	1	Fig. 270-U Bronze Gate	Oil Filter Manual Bypass
L	1	Fig. 762 Br. Swing Check	Prevent Reverse Flow

Code	Quan.	Jenkins Valve	Service
M	2	Fig. 950 Bronze Globe	Filter Drains
N	3	Fig. 743-G Br. Needle	Pressure Gage Control
P	2	Fig. 950 Bronze Globe	Filter Air Vents
R	3	Fig. 950 Bronze Globe	Oil Sampling Take Offs
S	2	Fig. 270-U Bronze Gate	Steam Supply to Oil Heater
T	2	Fig. 270-U Bronze Gate	Condensate Shutoffs
U	1	Fig. 762 Br. Swing Check	Prevent Condensate Backflow
V	2	Fig. 950 Bronze Globe	Condensate Bypasses Free Blow Trap Test
W	2	Fig. 270-U Bronze Gate	Centrifugal Shutoff
X	1	Fig. 270-U Bronze Gate	Centrifugal Bypass
Y	1	Fig. 956 Bronze Globe	Bypass on Automatic Steam Valve

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B **Place valves correctly in the line**

C **Choose Jenkins for lifetime economy**

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DEFENSE DIGEST

Your roundup of mobilization news and trends affecting power men

Reviews of power program show the last quarter of 1952 will tell the story. New capacity planned for service this year was heavily concentrated in third quarter (28%) and fourth quarter (46%). Some slippage has already occurred from delays in securing materials. For many of the units involved, only a few weeks means the difference between being available for December peak loads or not. Preliminary estimates indicate that as much as 3 million kw of capacity scheduled for 1952 might not see service until early 1953.

DEPA points out that demand on equipment manufacturers in 1952 far exceeds actual 1951 production. Schedule calls for 83% more turbine-generator capacity, 133% more boiler capacity and 37% more transformer capacity than was actually shipped in 1951. DEPA is making every effort to assure materials needed to meet this schedule and complete the 32-million-kw program in three years.

Scarce alloying elements columbium and tantalum are focus of a new Defense Minerals Procurement Agency program. A government-guaranteed purchase plan offers an incentive bonus which will about double current market prices for concentrates.

Industrial dispersion problems are fully covered in a new guidebook to help communities and manufacturers select sites for defense-supporting industries. In addition to telling how a community dispersion program is set up, booklet explains procedure for manufacturers in locating plants eligible for government assistance. Ask your local field office of the Dept. of Commerce, or Supt. of Documents, Washington, D. C., for "Industrial Dispersion Guidebook for Communities". The price is 20¢.

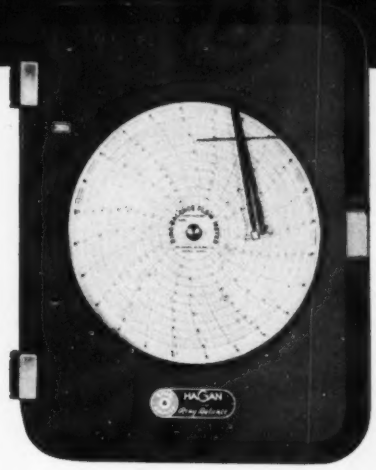
Controlled materials for maintenance, repair and minor capital additions will be somewhat easier to obtain because of a number of changes in procedure. For details, see CMP Regulation 5, as amended. Manufacturers of B products may obtain larger amounts of copper and aluminum on self-certification as a result of amendments to Directive 1, CMP Regulation 1.

Tubular heat-exchanger production (more than 95% for defense or defense-supporting activities) suffers from materials problems common to many fields. Biggest difficulty, however, is inventory limitations of CMP Regulation 2, which the nature of the industry makes impracticable and unworkable. NPA is considering relief.

1975 demands for energy and materials are forecast in 813-pg. report of the President's Materials Policy Commission. This careful study forecasts a doubling of the U. S. economy in the next 25 years. Resulting demand for materials will carry us further in the direction of chewing up more than we ourselves produce. Not absolute shortages but rising costs are the threat, they say. Positive action is needed to keep these predicted higher costs from holding down production.

Some specific forecasts for 1975: demand for all forms of energy (fuels and electricity) – double; for industrial water – up 170%; for minerals – double. Some recommendations: more resources exploration, pennanent stockpiling, stepped up research on production and use of materials. In the power field, atomic and solar energy is discounted as helping by 1975, high priority goes to hydro development, Federal aid for coal mining and research, use of new fuels.

Here is an easy equation—
HAGAN Ring Balance Meters = Dependability



WITH Hagan Ring Balance Meters you get accurate flow integration on oxygen, water, steam, gas, oil or other fluids. You get a meter that is rugged and sturdy, but still a precision instrument throughout. Design is simple and maintenance costs are low.

HAGAN RING BALANCE FLOW METERS are the most versatile meters available. A single meter unit can indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available which are capable of measuring differentials from 1" to 420" water column maximum and for static pressures ranging up to 15,000 psig.

Features of every HAGAN Ring Balance Meter include:

- **Ease of dead weight calibration**
- **No stuffing boxes**
- **Adjustable, full scale range**
- **Mercury level not critical**
- **High sensitivity at low flow rates**

For more information on how dependable Hagan Ring Balance Flow Meters can answer your metering problems, clip the coupon, or write, wire or call Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

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Please send me further information on Hagan Ring Balance Meters. I am particularly interested in _____

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METALLURGICAL FURNACE CONTROL SYSTEMS
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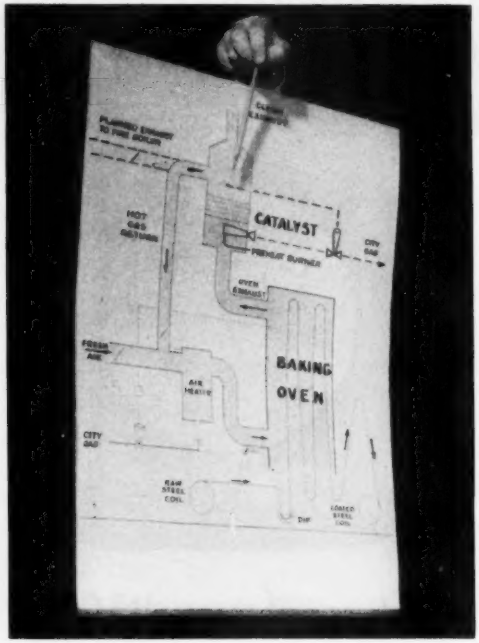
AND AUTOMOTIVE TESTING FACILITIES

READER SERVICE SECTION

POWER NEWS 148
TECHNICAL BRIEFS 150
PLANT EQUIPMENT NEWS 154
NEW FREE BULLETINS 163

HOUDRY, catalytic petroleum cracking inventor, developed catalyst-coated rods to change CO to CO_2 in engine exhaust



INDUSTRIES with similar problems, like Enamelstrip Corp, Allentown, Pa., put the idea to work on commercial ovens

Catalytic Aid to Process Air Pollution Control

When a man of the calibre of Eugene J Houdry, inventor of the famed Houdry catalytic cracking process for oil refining, comes up with a device to solve certain air pollution problems it rates serious consideration.

The device is a brick-like unit consisting of seventy-three 5½-in. long porcelain rods (see photo above, left) coated with a catalytic alumina and platinum alloy .003-in. thick. These rods are set in staggered rows and streamlined (tear drop in cross-section) to give good contact with gas flow over their surfaces and yet eliminate turbulence and heavy draft loss.

Given a gas heavy with hydrocarbons like that leaving the drying ovens of the Enamelstrip Corp in Allentown, Pa., and results are exceptional. The hydrocarbon vapors oxidize in the presence of these special catalytic rods and burn completely to CO_2 and water vapor. In a drying process like this one (photo above, right) the waste hot gases (they reach a stack temperature of 1500 F) can be recirculated through the drying oven and sharply reduce the usual fuel requirements.

But there are several catches, particularly when it comes to power field applications. The original models were marketed as mufflers for industrial truck exhausts (photo above, left). Results were top flight as long as the gasoline was unleaded. But once leaded gasoline was used the metal vapors contaminated the catalyst and action stopped. Today's designs (all marketed by the Oxy-Catalyst Mfg Co, Inc, Wayne, Pa.) suffer a similar limitation in that non-combustible solids carried in the exhaust gas stream cling to and smother the catalyst surface.

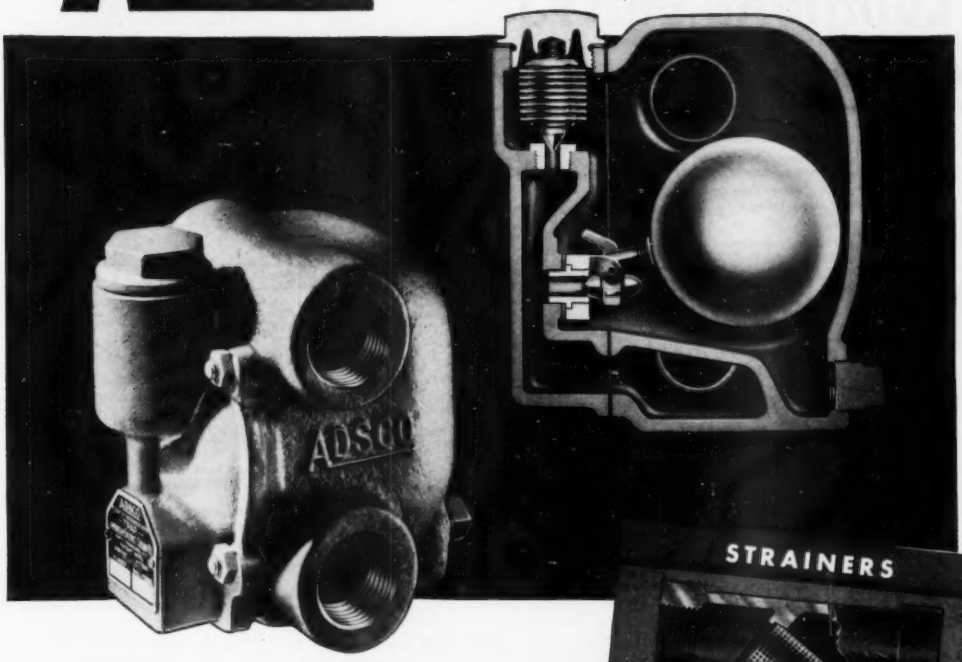
Further, in the case of lower grade oils which some press releases state can be burned at close to 100% efficiency with this new catalyst, present indications point otherwise. The combination of solids, vanadium, and a low quantity of unburned hydrocarbons in these fuels tends to work against any very noteworthy improvement in the overall combustion process with this or any other similar combustion aid.

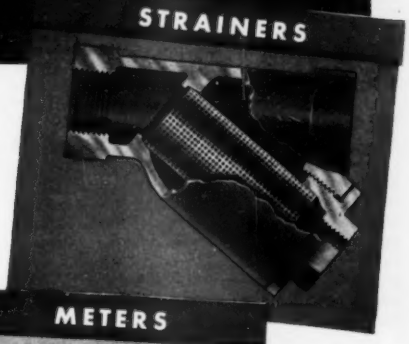
In much the same vein the early claims of 40% fuel savings as a result of making domestic oil burners 100%

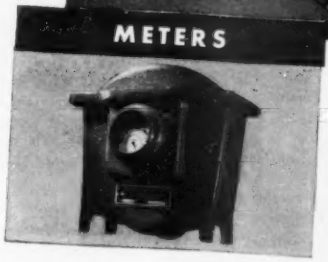
(*Continued on page* 196)

For **Coming Events** turn to page 196

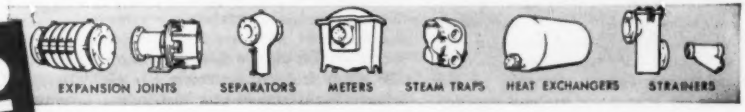
ADSCO DUAL STEAM TRAPS







For low maintenance costs, standardize on ADSCO Dual Steam Traps. ADSCO—and only ADSCO — builds traps with all working parts mounted on the cover. A new cover gives you a new trap. Repair original cover when convenient. Piping connections need not be broken for inspection or servicing. And here's another great feature: valve and seat are reversible, giving double life, double economy. For immediate service, phone your ADSCO Representative today. Shipment will be made from ample factory stocks.



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Latest engineering developments for busy power men

10 Digests for you on:
FUELS AND FIRING
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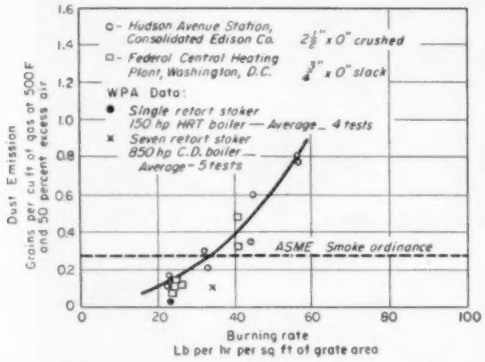
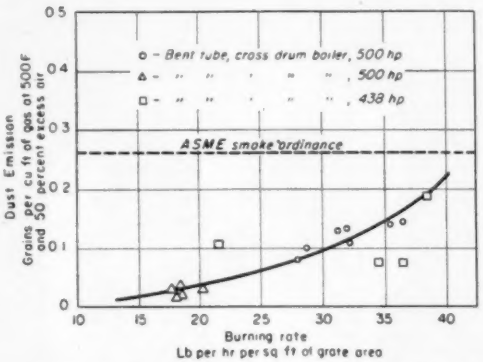
DUST COLLECTORS


Dust Emission
Grains per cu ft of gas at 500F and 50 percent excess air
Burning rate
Lb per hr per sq ft of grate area
ASME Smoke ordinance
WPA Data:
Single retort stoker 150 hp HRT boiler — Average — 4 tests
Seven retort stoker 850 hp C.D. boiler — Average - 5 tests

1 Flyash data on underfeed, traveling-grate stokers is spotty. Above is on single and multiple retorts for one case


Dust Emission
Grains per cu ft of gas at 500F and 50 percent excess air
Burning rate
Lb per hr per sq ft of grate area
ASME smoke ordinance

2 Usual operating range of low-capacity, chain grate stokers, above, gives little chance for flyash problems, nuisances

Fuels and Firing

Proper Coal-Firing Rates Prevent Air Pollution. *By C E Miller, Combustion Engineering-Superheater, Inc.*

It seems generally agreed that spreader stokers—the largest single class of stoker equipment—require flyash collections. Reinjection from the boiler hoppers generally reclaims some of the carbon loss and simplifies the ash-disposal system. This results in a somewhat higher concentration of dust in the flue gas.

The information on flyash emission from underfeed and traveling-grate stokers is not as complete. One set of interesting data was taken under government sponsorship in the Chicago area and assembled by Batelle Memorial Institute. Fig. 1 shows the information on typical single-retort stokers and on two large multiple-retort stoker installations.

Multiple-retort stokers are generally equipped with collectors, not that carryover from these units is particularly high at normal burning rates, but rather because they are of larger capacity and usually operate at higher burning rates, so have a higher *total* emission. Furthermore, because of their size, it is usually possible to justify higher standards of performance.

The flyash emission from the single-retort underfed stokers, operating at low burning rates, is well below the limits that would normally be called a nuisance. Further, these units are normally designed for a maximum burning rate of 30 to 35 lb of coal per hour per sq ft of grate area. But this rating is reached for only a few hours a year because they are generally used for heating loads, so flyash collectors are normally unnecessary.

Fig. 2 shows data on three small chain-grate stoker units. In the usual operating range of these low-capacity machines, it would seem that they should be placed in the same class as the single-retort underfeed stokers. Flyash should normally not be a problem, although this may not hold true with higher capacity units. *ASME paper. No number.*

Theory of Chimney Design. *By J G Mingle, Indianapolis, Ind.*

Chimneys are dependable in operation, possess lasting qualities, lack mechanical parts, and have a low cost of operation. Yet despite these advantages they suffer from an extremely low efficiency, high original cost, and inflexible operation.

For some unaccountable reason an air of mystery and misunderstanding surrounds the theory of natural draft and operation of natural draft chimneys.

The author's paper applies theory to the performance of natural draft chimneys, and finally translates performance theory into chimney design or determination of the stack size.

The paper aims at clearing up confusion and does a first-rate job. Many excellent illustrations, plus a very helpful table aid in presenting this highly theoretical subject in an interesting way. *APSPAA paper. No number.*

Air Pollution

Spreader Stokers and Their Relation to Air Pollution. *By Earle C Miller, Riley Stoker Corp.*

The designer of steam generating units should not have to guess about items vital to air pollution. The load range and fluctuations in the load are vital design factors, and the greatest danger of air pollution comes in the extreme ends of the load range. Unless adequate provision has been made for both high and low loads, operation is bound to suffer. Burning rates, fan sizes, and combustion control equipment must be selected for the character of the load.

Specifications frequently cover a wide range of fuels with a reasonably good coal as the basis for design. While the spreader stoker is very flexible with respect to fuel quality, fuel characteristics

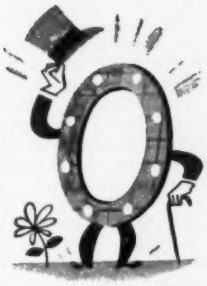
How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

The right type of gasket -properly installed -saves many a costly sealing headache...

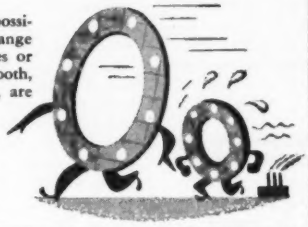
Be sure I'm in style.

It's hardly worth while to use inferior quality gasketing for a replacement job, when the right style of a *good* quality gasket material can generally be easily and inexpensively obtained from your near-by Packing Distributor. Therefore, for a packing that will give good service, be sure the style selected is the one recommended for your conditions.



I work better when I'm thin.

Use as thin a gasket as possible for the particular flange condition. When flanges or surfaces are flat and smooth, thin gaskets, as a rule, are better than thicker gaskets. Where surfaces are rough and do not line up perfectly, thicker gaskets usually do a better job.



Don't use oil on me!

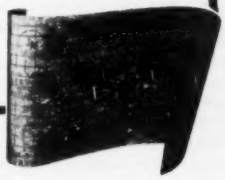
Often gasket materials have rubber in their composition, and oil causes deterioration of rubber. If it is desirable to graphite one or both surfaces of the gasket for easy removal, use a solution of graphite and water, with or without a small amount of glycerine. If the joint is to be permanent, it is better not to treat the gasket at all.

I give better service if you follow these rules, too.

1. Ring-cut gaskets are preferable to full-face gaskets. 2. See that the gasket is properly centered and does not project inside the flanges. 3. Make sure flanges are perfectly clean and true. 4. See that flange surfaces line up and are parallel. 5. Follow up bolts the next day after installing new gaskets.

Why you'll get a better sealing job from J-M SERVICE® SHEET GASKET
Style No. 60

Service Sheet owes its superior performance ability to the care used in its manufacture to produce a consistently uniform product. It is made of selected long fiber asbestos and special heat-resisting compounds, bonded together under heat and pressure. The result is a tough, durable sheet without plies or laminations. It is unusually pliable and resilient and does not dry out in storage. It is effective against superheated steam, air, gas, water, hot oil, ammonia, and many acids and other chemicals.



Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 60, New York 16, N.Y.

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Johns-Manville PACKINGS & GASKETS

More TECHNICAL BRIEFS

Begins on page 150

do have a pronounced effect on air pollution. The common practice of referring to volatile content alone when making guarantees on smoke emission is not satisfactory, for volatile content is not the only factor that influences the smoke. Burning characteristics, the swelling index of the coal and whether it is free-burning or coking are significant. Although ash content is frequently considered unimportant for spreader stoker fired units, it does play an important part in air pollution, particularly on dumping grate units. And the effect of the very fine particles of coal upon dust is apparent.

The customer cannot generally provide detailed information on the coal, but he can usually establish the source and seam of the coal, its size, ash content, ash fusion temperature, and sulphur content.

Furnace design—grate area, furnace volume, furnace height (grates to tubes), furnace cooling (such as water wall surface)—greatly influences smoking tendencies. In a similar vein, preheated air tremendously affects low-load boiler performance. *APSPAA paper. No number.*

Spreader Stokers as Sources of Air Pollution. *By M O Funk, Combustion Engineering-Superheater, Inc.*

Historically, no one design feature is responsible for the recent generally improved performance of spreader stokers and no single correction or addition to a unit can change it from a smoke violator to a non-violator. All features of design and operation must help maintain certain basic conditions in a spreader furnace. These are: (1) equal burning on each unit of grate area, (2) adequate mixing of the combustible material, (3) air at temperatures that will carry combustion to completion quickly, (4) sufficient time or flame travel for combustion to take place before the gases pass over heat absorbing surfaces.

If coal and air distribution over and under the grate are equal and the supply of each to the grate is maintained equal, one basic requirement for good operation is met. If it were possible to have an infinite number of air openings through the grate, the second basic requirement could also be met at the grate line. However, even though air can be directed through the grate so the combustibles and air will mix, some means of inducing mixing above the grate line is generally necessary. Using steam or air jets and using arches to some extent has been widely explored.

Furnace temperatures at and immediately above the grate line are extremely important for smokeless operation. When these temperatures fall too low, smoke results. Temperatures are a function of burning rate, or grate heat release, and excess air. In our selection of equipment we attempt to keep burning rates on the grate above 125,000 Btu per sq ft per hr at the lowest point of continuous operation.

Excess air in spreader furnaces must remain constant for a given set of conditions and should vary inversely with burning rates on a given stoker. This requirement in combination with the spreader stoker's ability to change burning rates rapidly makes automatic combustion control essential for acceptable operation.

The final basic requirement for good operation is adequate time or flame travel for the combination of combustibles and air before the gases pass over heat absorbing surfaces. The necessary time for completing the combustible combination can be gained through low vertical gas velocities and high furnaces. Typical, recent furnace designs are illustrated. *APSPAA paper. No number.*

Converting Existing Coal-Fired Boilers to Meet Air-Pollution Codes. *R M Van Duzer, Detroit Edison Co.*

The rapid post-war increase in the use of electricity, and the greatly increased cost of new generating capacity, has reduced plant generating reserves. This results in using old boilers at high ratings during the peak-load periods of the day, causing emission of too much fly ash. Likewise, because of reserve limitations, it is difficult or impossible to shut down boilers of 40,000 kw generating capacity for periods up to the three months needed to install the average dust collector.

Fitting collectors into existing boiler house space requires rearranging building steel, gas ducts, piping, fans, electrical bus structures and the like. The engineering can be extensive depending on the type of equipment required, whether mechanical or electrostatic. In some cases, building limitations may require compromise in selecting the equipment because of size, weight or draft loss.

How the dust will be handled and the method of disposal must be considered. Such systems can become extensive if the dust is transported for any distance within the plant. The transport system must be designed to miss existing plant equipment and other interferences. It is fortunate if the collected ash can be mixed with cinders for which a disposal means is in operation. Likewise, if the collected refuse is high in carbon warranting reinjection into the furnace, disposal may be simple and economical. But where a salable cinder may be degraded by the fly ash, other disposal must be provided if the cinder market is to be retained.

Paying for a dust collector program becomes important, especially if a number of boilers are involved. Engineering and construction is costly where existing building design must be changed and where adjacent equipment must continue operation.

Such expenditures contribute to the public benefit. However, no increase in operating efficiency is realized and fixed operating charges are increased. The author goes on to describe a dust collector program at the company's Delray plant. *APSPAA paper. No Number.*

Scrubbing Devices for Air-Pollution Control. *By E P Kropp, R N Simonsen, Standard Oil Co. (Ohio).*

In cooperation with the municipal program, potential sources of air pollution from refinery operations were investigated. These investigations showed that, in the *Sohio* operations, there were three major sources of possible air pollution, as follows:

1. *Acid Treating of Lubricating Oil Stocks:* The conventional sulfuric-acid treatment of lubricating-oil stocks and

(*Continued on page* 186)

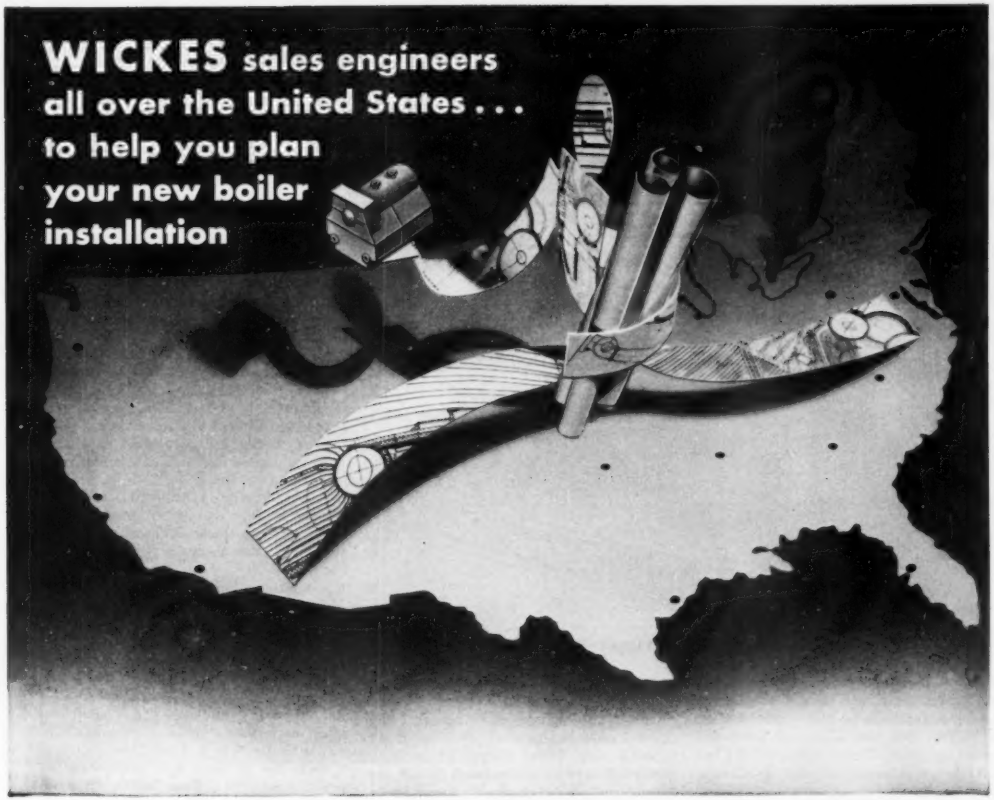
TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source not POWER.

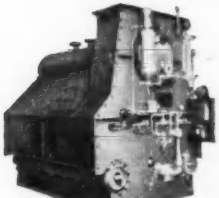
American Society of Mechanical Engineers, summer meeting, Sheraton Gibson Hotel, Cincinnati, Ohio, June 15-19. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Air Pollution and Smoke Prevention Assn of America, annual meeting, Statler Hotel, Cleveland, Ohio, June 8-13. Identified by initials APSPAA and obtainable in official Proceedings to be published through APSPAA secretary Griebling, Mellon Institute, Pittsburgh, Pa.

WICKES sales engineers all over the United States . . . to help you plan your new boiler installation



In twenty-three principal cities in the U. S. and in several industrial centers outside the country there is a Wickes sales engineer—who really knows boilers—ready to help you. This widespread sales organization, alone, helps greatly to increase the service you get from Wickes, and once you place an order for a Wickes boiler, Wickes engineers and production men get into production without delay. Wickes knows that when you want steam generating equipment, you want it. A Wickes installation is a complete installation. One contract covers all controls, all accessories, all engineering, all work from original survey to final brick-work and installation ready-to-go. ✓ ✓ ✓ Throughout the world, industries and institutions that depend on steam have learned to depend on Wickes for efficient, low cost steam power. Wickes can fill your requirements for steam generating equipment up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing. Write today for complete information or consult a Wickes sales engineer.



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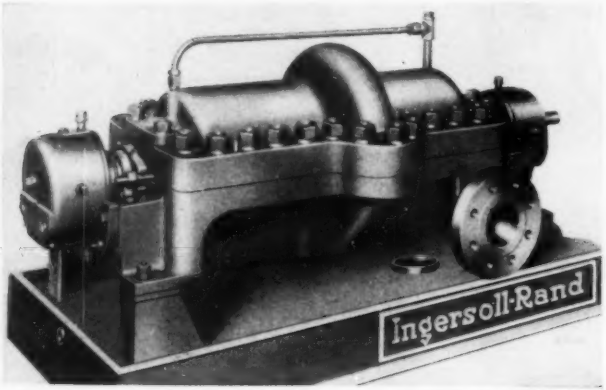


MULTI-STAGE CENTRIFUGAL PUMPS

P806 • Redesigned line of horizontal, multi-stage centrifugal pumps for medium-pressure applications incorporate modern hydraulics that give higher efficiency and better operation. These pumps, called Class CNTA, are intended for boiler feed, mine dewatering, marine, refinery and general industrial services to 800 psi. Built in 1½, 2, 2½ and 3-in. sizes, units are available with 4, 6 or 8 stages.

The Class CNTA pump features a horizontally-split, smooth-bore cylindrical casing containing the *Unit-Type* rotor assembly. Assembly is composed of shaft, impellers, and channel rings which contain the multiple-volute fluid passages. Entire rotor assembly is easily removable from and installed in the smooth-bore casing, since there are no mating ring fits or delicate alignment problems.

Completely balanced rotor eliminates radial thrust at all operating conditions. Back to back grouping of impellers neutralizes axial thrust developed by pressure differential across each individual stage.

Interstage sealing method utilizes alloy cast-iron or stainless-steel piston ring around outer diameter of each individual channel ring. These hydraulic-type, step-seal rings have a metal-to-metal fit with the casing and are automatically placed under correct compression when casing halves are bolted together. They are highly resistant to corrosion and unaffected by high temperature.

Ball bearings, ring oiled from their own reservoirs, are standard, although sleeve bearings may be obtained if desired. Stuffing boxes may be packed solid or arranged for injection or circulation, as best fits the application. The *Cameron* shaft-seal may be installed where difficult liquids are encountered. Water-cooled stuffing boxes are standard on pumps with steel casings and can be provided with cast-iron construction if requested.

Ingersoll-Rand Co, 11 Broadway, New York 4, N.Y.

GAS, OIL BURNER PROGRAMMING

P844 • *Fireye* programming control type 26RJ8 is designed for automatic starting and programming control for commercial and industrial gas, oil, and combination gas/oil burner equipment. It is used with *Firetron* scanner type 48PT1 to protect burner installations from flame failure.

Control automatically starts a burner in operation and programs a sequence of pre-purge, ignition-on, fuel-valve delay, post-ignition timing, and post-purge. Its instantaneous response to flame failure results in complete fuel cut-off in 2 to 4 seconds, providing maximum protection from explosion. Built-in time delay prevents false shutdown from transient effects like smoky streaks in the flame or irregular draft conditions.

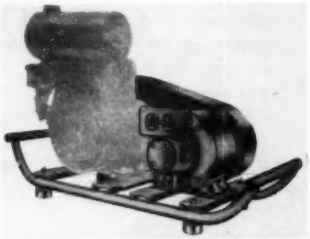
Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.

ALARM SILENCING RELAY

P826 • To prevent failure to reclose alarm switch after alarm has sounded, the alarm silencing relay disrupts alarm yet displays red light until faulty condition is corrected. Upon correction of fault, alarm circuit is automatically reset and red light goes out.

Relay can be used with temperature or pressure controllers, flame-failure safeguard systems, or in any other application where alarm actuation is involved.

Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.



ENGINE-DRIVEN GENERATOR

P832 • New generator is available with or without engine. Engine is easily dismounted by removing V belt and several frame bolts and can be used separately to drive concrete mixers, compressors, pumps, etc. When emergency power shortage occurs or portable power is needed, engine can be quickly reassembled with the generator. Units are offered in ratings of 300, 500, 1350, 2500 and 10,000 watts.

Wincharger Corp, E 7th & Division, Sioux City, Iowa.

(*Continued on page* 156)

For more data on these items, use post cards, p 143. Identify request with P and number.

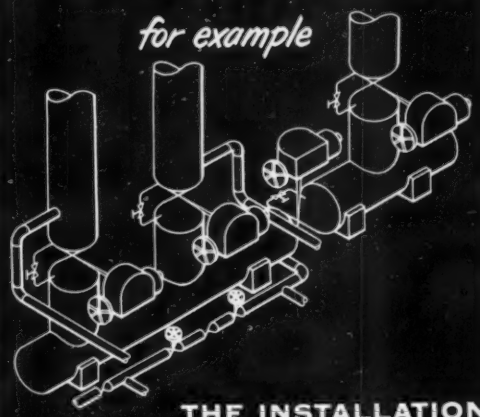
BLIND RIVETING ANGLE ADAPTER

P827 • One person from one side of work can now drive *Huck* ⅛-, 5/32-, and 3/16-in. diameter self-plugging or pull-through blind rivets in a clearance space of only 4 in. from nose of riveting tool to back face of angle adapter. It fits into a *Huck* ℱ93 air riveting tool or a ℱ94 hand riveting tool and simplifies assembly of previously inaccessible deep channels, hard to reach corners and otherwise impossible to rivet locations.

Huck Mfg Co, 2480 Bellevue Ave, Detroit 7, Mich.

Are Your Valves Giving this Low-cost Service?

...on Main Steam Lines, for example



THE INSTALLATION

Crane 900-Pound Pressure-Seal Bonnet Gate Valves, motor-operated, on main steam header, in a mid-western public utility power station.

VALVE SERVICE RATINGS

FEATURES: Pressure Seal Bonnet Joint and Flexible Wedge Disc

SUITABILITY: Latest High Pressure Service Design

MAINTENANCE COST: None in 4 years - except lubrication

SERVICE LIFE: Should outlast any bolted bonnet valve

OPERATING RESULTS: No forced outages for valve repairs

PRICE: In line for modern, high quality valves

AVAILABILITY: Regular item in Crane line

THE HISTORY

This battery of 10-inch Crane Pressure-Seal Bonnet Gates has been in operation about 4 years on 825° F. —825 psi steam. Their performance is rated in direct comparison with bolted-bonnet valves, same size and pressure class, on identical service in the station.

While installed some years earlier, the bolted-bonnet valve records show considerable repairs for seat leakage, and difficulty in keeping bonnet joints tight. The plant also reports trouble with discs sticking shut.

In contrast, Crane Pressure-Seal Valves have given satisfaction since installed. Seats and bonnet joints alike remain leak free, tight as new. Valve operation is smooth and positive.

THE VALVE

Here is simplified development of the pressure-seal bonnet principle. Crane Pressure-Seal Gate Valves eliminate bonnet joint leakage and maintenance with a one-piece seal ring design, using no gaskets or auxiliary parts. Readily accessible, the joint needs no special tools for dismantling. Self-adjusting to temperature effects, Crane flexible wedge disc prevents sticking; takes minimum torque to open, hot or cold. See your Crane Representative or your Crane Catalog for full data on these modern valves in 600, 900 and 1500-pound pressure classes.

The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

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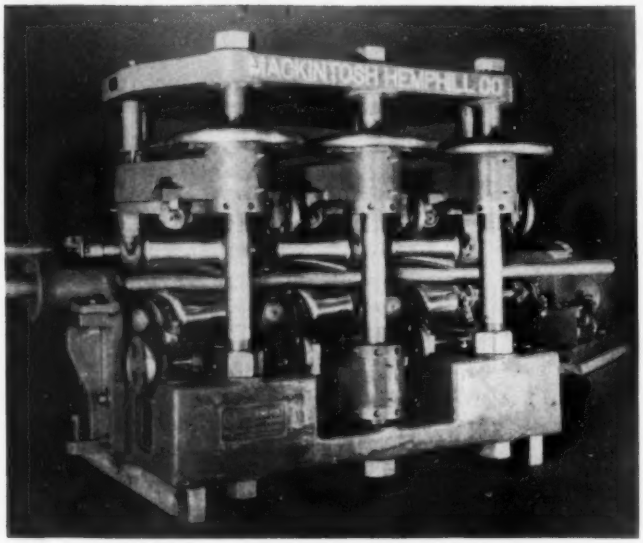


GUIDELESS ROTARY TUBE STRAIGHTENER

P817 • *Model AN* guideless rotary tube straightener will straighten steel tubing in commercial pipe sizes from ½- up to 1¾-in. OD, also brass, copper, aluminum and other non-ferrous metal thin-wall tubing in sizes up to 3 in. OD.

Two highspeed, silent chain type drives, actuated by two 10-hp dc motors, drive all six forged and hardened alloy steel rolls. These are equipped with antifriction bearings. Production speeds from 40 to 400 fpm are obtainable depending on type, size and material being straightened. The closed offset-center-pass principle is used. And the *Model AN* is guideless, assuring high surface quality of tubing. Likewise, because practically 100% of entire body length of each crossed roll bears on the tube being straightened, roll wear is said to be equalized and minimized.

Other advantages claimed are: (1) straightening to precision tolerances, end to end; (2) finishing without spiral scratches or rub marks on exterior surfaces; (3) removal of end bends from cut-length stock, and consistent production of perfectly round tube, (4) high operating speed and ease of adjustment to accommodate various size stock.

Roll body length is 9½ in., roll diameter at center 6 in., floor space 12 ft 9 in. by 8 ft 7 in., weight 11,500 lb.

Mackintosh-Hemphill Co, 901 Bingham St, Pittsburgh 3, Pa.

For more data on these items, use post cards, p 163. Identify request with P and number.

EARTH-RESISTANCE METER

P857 • Model JP *Ground-Ohmer* is instrument for earth resistance measurements for power circuits and soil investigation. It operates on the potentiometer or drop of potential principle and incorporates an ac magneto generator of the hand cranking type.

Instrument is direct reading in ohms by simple manipulation of the graduated dial of the variable resistor. *Ground-Ohmer* has three measuring ranges, 10, 100 and 1000 ohms. Two variations are made, one designed for testing the earth of power plants, high tension lines, lightning arresters, etc, the other for investigating soil conductivity on building sites, etc.

Herman H Sticht Co, Inc, 27 Park Pl, New York, N. Y.

WINDING TESTER

P846 • Portable electronic winding tester can detect a single shorted turn of No. 40 awg wire. Instrument is designed to detect faults in and to prevent breakdowns of electrical motors and generators, coils and similar electrical equipment. It is a practical "tool" for preventive maintenance, production control and motor repairs.

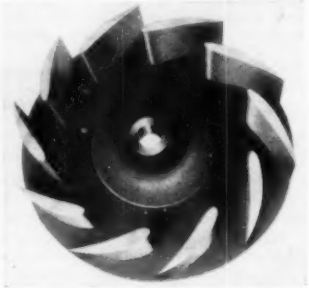
The *PMD Tester* enables user in a matter of seconds to detect location as well as nature of an electrical fault in any type of winding. Location of open circuits, shorts to ground, shorts between phases or between turns, reversed terminal connections, wire breakage, and material defects can be found in a minimum of time even with unskilled labor.

Columbia Technical Corp, 5 E 57th St, New York 22, N. Y.

WATER CONDITIONER

P810 • *Pur-O-San Extra* is a complete conditioner for treating water used in heat exchangers, is readily soluble and provides full protection regardless of characteristics of water used. When added to water, it is non-toxic, non-volatile, heat stable, and eliminates free oxygen. It protects against corrosion by adsorbing at metal surfaces in a thin, impervious film. This film barrier retards thining of tube walls, yet does not change clearance between baffles and shell. It gives full protection from algae and sludge, keeping system free and clean at all times.

The Pur-O-San Co, Bradford, Pa.



AIRFOIL CENTRIFUGAL FAN

P807 • New type non-overloading centrifugal fan is over 90% efficient with only 1/3 the noise intensity of previous models. Designed especially for industry, power, and commercial needs, the new fan ranges in wheel sizes from 40¼ to 108¾ in. diameter and can deliver up to 600,000 cfm.

New airfoil blade design along with aerodynamic changes in inlet and casing has boosted mechanical efficiency at peak to 92%, an 8% increase over current designs.

Westinghouse Electric Corp., Sturtevant Div, 200 Readville St, Hyde Park, Boston 36, Mass.

(*Continued on page 158*)

"Tycol Aturbrio never lets you down... turbines run for years without trouble"

How true! Tycol Aturbrio Oils are "double inhibited" to prevent oxidation and rusting. They provide maximum resistance to emulsification . . . permit continuous operation without sludge formation — performing for years without an oil change, completely eliminating, in many cases, down-time-high-cost maintenance.

Complete and detailed information on Tycol Aturbrio Turbine Oils is available from your nearest Tide Water Associated office. Call or wire today.

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TIDE WATER ASSOCIATED OIL COMPANY

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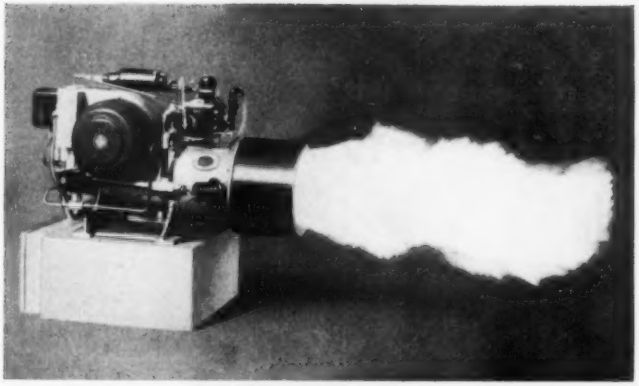
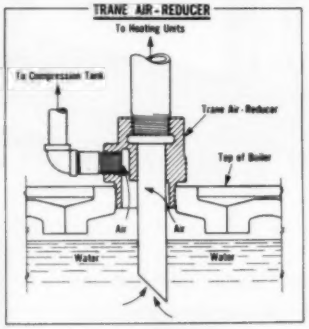


ROTARY BURNERS HANDLE ANY GRADE OIL OR GAS

P833 • Originally made exclusively for use with *Superior* steam generators these burners are now available for conversion and replacement use as well as for new installations. They provide dependable, automatic operation, precise control of firing rates, more accurate control of flame contour and minimum upkeep. Units feature: (1) horizontal rotary design, (2) V-belt drive for high cup speed (3) oil heater on pressure side of pump, (4) adjustable air nozzle, (5) dual pumps and reservoir combined with constant oil-rate control for controlled firing regardless of viscosity variation. Burner can handle any grade oil and is available with combined gas burner for any type gas. It is fully automatic in sizes to 500 bhp with dual ignition and hi-low or fully modulating control. These features increase adaptability to conversion jobs.
Superior Combustion Industries, Inc, 1475 Broadway, New York 18, N. Y.

DIAMOND WHEEL LAP

P821 • Life of cutting tools can be increased 3 to 6 times and sharp finish-lapped cutting edges obtained by using this new method of wheel lapping. *Spectrum* diamond lapping compound in any desired grit size is applied to special *Spectrum* lapping wheels. Wheels retain their shape, wear indefinitely and are interchangeable on all tool grinders. Wheels and lapping compounds in 12 standard grit sizes are available.
Penn Scientific Products Co, 5941 Alma St, Philadelphia 24, Pa.



AIR REDUCER

P809 • An easily installed fitting for removing air at the boiler, this hot water heating specialty eliminates two adapter connections, allows easier, faster and more economical boiler installation. Brass inner tube extends hot water system's supply main below the surface of water in boiler, preventing air from entering piping and heating units. Air collecting at top of boiler is bled off to compression tank through outer casing.

The *Air-Reducer* is made for boiler and main sizes from 1x1½ to 3x4 in., in standard increments. Additional information in Bulletin J-355.
The Trane Co, La Crosse Wis.

DIESEL ENGINE PYROMETER

P848 • Portable diesel-engine pyrometer is designed for test purposes and for installations where no permanently mounted pyrometer is available. Thermocouples can be installed in each cylinder and in main exhaust line. Temperatures can be checked at any time by inserting pyrometer prongs into corresponding receptacles in terminal head of the thermocouple.
The Bristol Co, Waterbury 20, Conn.

OVERCURRENT RELAY

P840 • *Type CO* protective relay is a slow-speed overcurrent type with inverse or very inverse time characteristics. Used principally for protecting transmissions and distribution lines, the relays are available in one of three ranges: 0.5- to 2.5-amps, 2- to 6-amp, or 4- to 12-amp.

Accurate timing is provided by adjustable magnetic plugs in the newly designed *E* element electromagnet. Accurate pick-up at tap value of current for all disc positions is provided by two independent adjustments. Accurate adjustment of damping torque of permanent magnet made by keeper screw without moving magnet. Relay is mechanically and electrically interchangeable with old *Type CO* relay.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

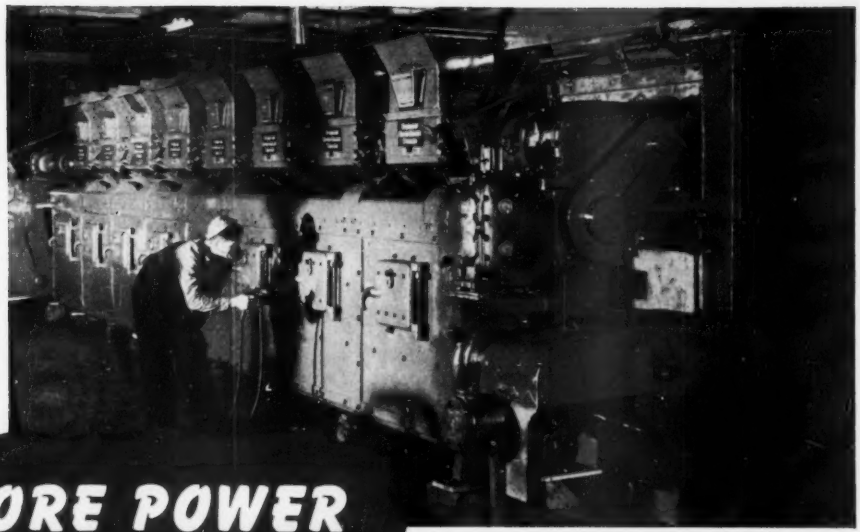
FLEXIBLE PIPE FITTINGS

P808 • New insert-type ell and tee couplings for sharp turns or takeoffs from flexible plastic pipe let one fitting effect a connection where three or four were needed. Fittings are quickly joined and pipe sections cut using only screwdriver and saw. Stainless steel clamps tightened over pipe and fitting draw pipe down onto serrations of insert, insure positive, leakproof joint. Connections can be made in less than two minutes.

All fittings are molded from single pice of thermoplastic material and are guaranteed against rot, rust and electrolytic corrosion. They are extremely light, easy to handle, and assure permanent, leakproof connections.
Carlon Products Corp, 10225 Meech Ave, Cleveland 5, Ohio

(*Continued on page* 160)

For more data on these items, use post cards, p 163. Identify request with P and number.



MORE POWER FOR GREECE

One of the four Detroit Rotograte Stokers of eight feeders each.

DETROIT ROTOGRATE STOKERS TO ISLAND OF EUBOEA

Four Detroit RotoGrate Stokers have been shipped to the Kingdom of Greece. Each Stoker will fire a 200,000 pound per hour capacity unit. Design is based on locally mined low-grade Lignite of 5,000 minimum BTU per pound and 35% moisture, and an ash fusing temperature of 2140° F with preheated air of 325° F. Steam pressure will be 925 psi, at 905° F. TT. The installation is at Aliveri Thermal-Electric Station, Island of Euboea. Design is by Burns and Roe, Inc., Engineers, New York, under supervision of Ebasco Services, Inc.

Detroit RotoGrate, an improved spreader stoker, will burn all grades of Bituminous Coal or Lignite with high thermal efficiency. Controlled turbulence permits higher burning rates per square foot of grate. Reinjection system is rugged, dependable.

Write for Detroit RotoGrate Bulletin.

DETROIT STOKERS have been selected for plants around the world such as in:
ENGLAND • SCOTLAND
DENMARK • FRANCE
BELGIUM • ITALY • SPAIN
PORTUGAL • MOROCCO
GREECE • TURKEY
RUSSIA • POLAND • NIGERIA
UNION OF SOUTH AFRICA
INDIA • MALAYA • CHINA
AUSTRALIA • NEW ZEALAND • TASMANIA
PHILIPPINES • HAWAII
ALASKA • COLOMBIA
CHILE • BRAZIL

There is a Type and Size Detroit Stoker for Every Industrial Need

4842

DETROIT STOKER COMPANY

More EQUIPMENT NEWS

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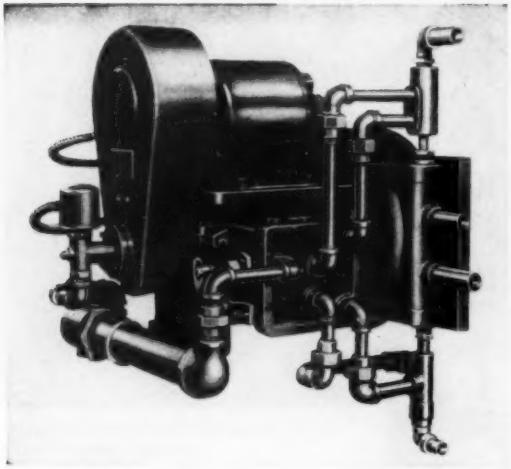


INDUSTRIAL AND COMMERCIAL BURNERS

P822 • These new industrial and commercial burners are known as AM5-H and the AM6-H. The AM5-H, with 25 gph capacity, has an overall width of 20 in. instead of the older model's 31 in. enabling more practical side-by-side installation. Height of the center of combustion cone to floor is 8½ instead of 11 in., making it unnecessary to pit in front of boiler on most jobs. It is also lighter than old models, and switch panel box is included.

Oil tubing in new model is simpler, neater, more convenient, and relay and motor starter are mounted in switch panel box. Convenient feature is separate tank to hold air-pump lubricating oil. Power losses and lack of air due to belt slippage are averted by use of direct-connected pancake motor. Electronic relay gives safe flame-failure protection.

The AM6-H, capacity 40 gph, uses virtually the same casting as the AM5-H, except that: (1) the AM6-H has a 3-hp instead of 2-hp motor, (2) it uses a larger oil pump, (3) it has a larger dry oven and air diffuser.

Installing either model is as simple as putting in a light oil burner, and operation features are comparable to automatic domestic burners. Both furnish all combustion air under forced draft.

Cleaver-Brooks Co, Hev-E-Oil Burner Div, 326 E Keefe Ave, Milwaukee 12, Wis.

INSPECTION LIGHT

P841 • Bright beam is directed inside a cavity or crevice to speed inspection, grinding, machining and other precision work. Different attachments to direct light are made to specially fit individual needs.

Eder Instrument Co, Dept 42, 2298 N Clybourne, Chicago Ill.

For more data on these items, use post cards, p 163. Identify request with P and number.

ION EXCHANGE RESIN

P831 • New low-cost medium-capacity cation exchange resin, *Amberlite IR-112*, has high regeneration efficiency, low leakage characteristics, and is said to have all the desirable physical and chemical properties of the polystyrene nuclear sulfonic-acid class of exchangers. It is resistant to oxidizing and reducing agents as well as solvents, is stable up to 250 F and over the entire pH range, and is the most porous cation exchanger made to date for commercial use.

Low cost, economical regeneration and efficient exchange properties suggest use on such applications as split stream dealkalization for boiler feed, bottling, and other processes requiring soft, dealkalized water. Resin is ideal for both monobed and multiple bed deionization. Hydrogen cycle performance is particularly good at intermediate and low regeneration levels.

Rohm & Haas Co, Washington Sq, Philadelphia 5, Pa.

CHECK THESE TOO! . . .

Oxygen Therapy Unit ..... p 168
Time, Temperature Control ..... p 170
Magnetic Fixture ..... p 172
Surface Pyrometer ..... p 172
Automatic Tank Gage ..... p 174
Flow-Rate Regulator ..... p 176
Solderless Connector ..... p 180

RADIANT HEATING MAT

P860 • Rubber mat with built-in radiant heating unit is suitable for warehouses, hotels, unheated and refrigerated areas of industrial plants. It provides greater comfort for employees encountering cold working conditions around their feet. Operating temperature maintained in mat is 35 F above surrounding temperature. Current supply is 110 v.

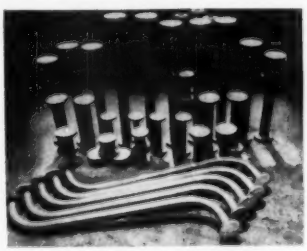
United States Rubber Co, Rockefeller Center, New York 20, N. Y.

DEALKALIZATION PROCESS

P823 • New process equipment for softening and dealkalizing water and increasing capacity of anion exchange resins by 50% is easy to install and operate. Resins absorb objectionable sulfates, carbonates and other anions. However, exchange capacity of resin was found to be extremely low when only common salt was used as regenerant, due to formation of blanketing gases that prevented complete regeneration.

The pH of regenerant solution has been raised, and gas blanketing tendency eliminated. This also improves quality of effluent.

American Water Softener Co, 330 W Lehigh Ave, Philadelphia, Pa.



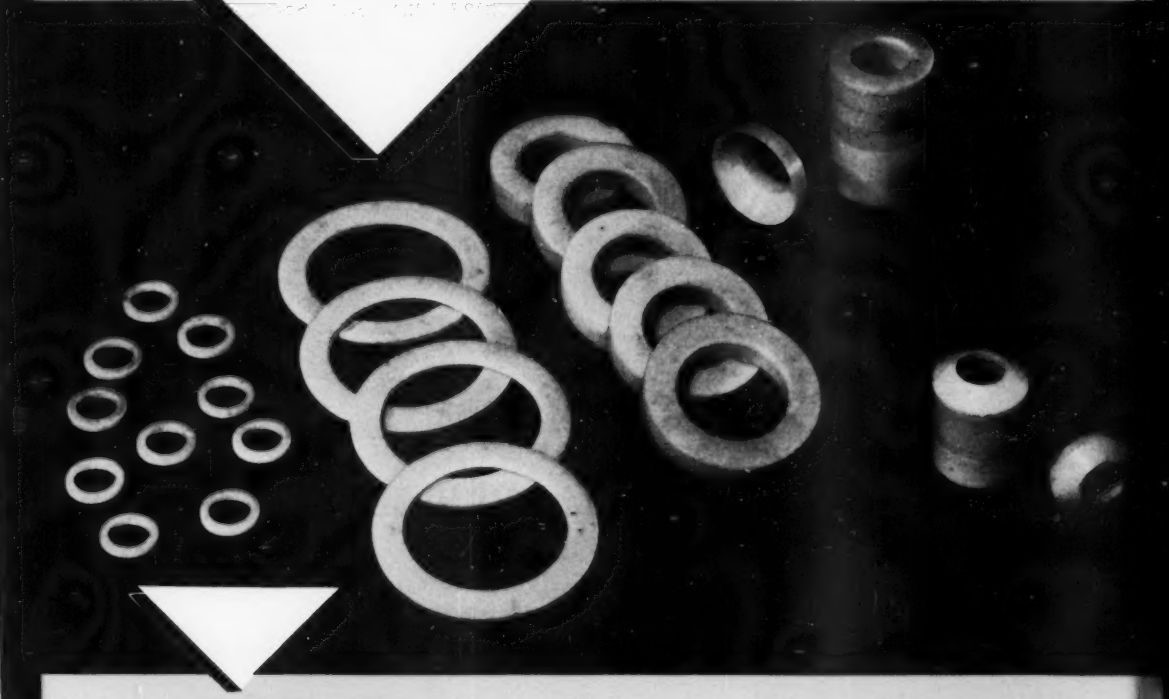
RUBBER PIPE LINING

P814 • Used for lining and covering pipe, fittings and process equipment, new rubber lining permits insertion of fittings in marine and industrial installations where space clearances are limited. Pipe from 1½ in. up to any transportable size can be lined, even when it has special bends. Fittings can be installed without interrupting flow.

La Favorite Rubber Mfg Co, 264 Wagaraw Rd, Paterson, N.J.

(*Continued on page* 168)

ANKLON . . . Made of TEFLON



RECOMMENDED for all types of Valve Stems, Rotating and Reciprocating Shafts

BRANCH OFFICES

BALTIMORE, MD. — MILWAUKEE, WIS.
BOSTON, MASS. — MONTREAL, CANADA
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CHICAGO, ILL. — PHILADELPHIA, PA.
CLEVELAND, OHIO — PITTSBURGH, PA.
DAYTON, OHIO — SAN FRANCISCO, CAL.
DETROIT, MICH. — SEATTLE, WASH.
HOUSTON, TEX. — SPOKANE, WASH.
INDIANAPOLIS, IND. — ST. LOUIS, MO.
LOS ANGELES, CAL. — TOLEDO, OHIO
WILMINGTON, CAL.

Anklon is a superior plastic packing, fabricated by The Anchor Packing Company from Du Pont's Teflon and formed into sheets, rods, angular rings and blocks.

Because of the inert physical qualities of Anklon, packings, gaskets and machined parts made of this product are ideal for use against acids, solvents and alkalies and also have many desirable characteristics for application in the electrical, food processing and many other fields.

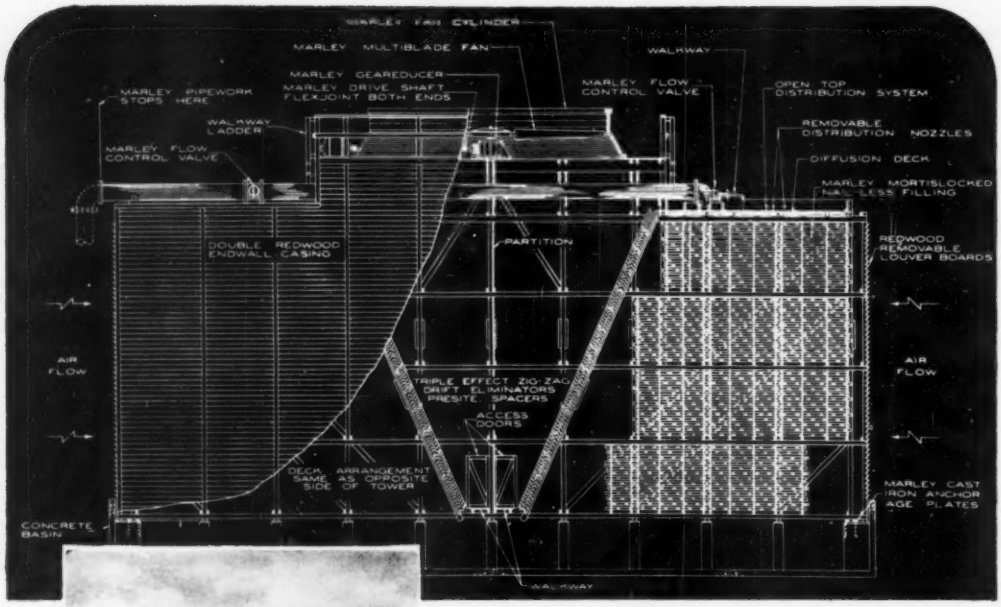
Illustrated are Anklon machined packing sets ideal for use on slow moving rotary and reciprocating equipment and excellent for all types of valve stems. Anklon seals with low gland pressure. Flat adaptors are furnished when necessary. Where small valve stems are unable to utilize wedge or angular ring sets, solid unit rings are supplied. For full information, write today.

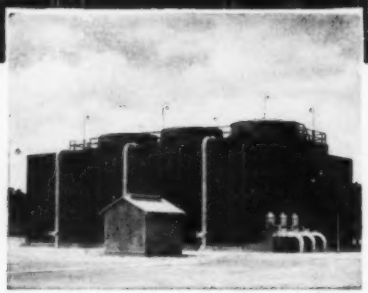
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE





for DESIGN and PERFORMANCE

Engineers who know, choose MARLEY Double-Flow

Marley Double-Flows cool 13 billion gallons of water daily . . . more than any other type of tower. The reason why Double-Flows are the outstanding choice of engineers for industrial service is the combination of exclusive features only Double-Flow offers.

Such distinctive design features as open distribution, full height louver walls, MortisLocked filling, rugged structural strength and mechanical equipment engineered exclusively for cooling tower service are the advantages engineers demand and find only in Double-Flows.

These features mean high efficiency performance . . . unique flexibility of operation . . complete accessibility of all parts of the tower . safety for operators . . . inspection and maintenance with least possible effort.

Repeat orders are the best criterion of performance for cooling towers, and in industry after industry multiple installations of Double-Flow cooling towers are the dominant rule. Many plants use from two to ten or more Double-Flows and in one industrial organization, 33 of these modern cooling towers are in daily service.

producers of

DOUBLE FLOW TOWERS
DRICOOLERS
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NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES
DOUBLE FLOW AQUATOWERS

MARLEY

The Marley Company, Inc.

KANSAS CITY 5, MISSOURI

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more info on any of them, write in their numbers here

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your requests to the various companies, they'll send the info

Want quick direct-from-manufacturer service?

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- First check what you need: more information on a new product or an ad, copies of free catalogs, bulletins
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Send me these FREE Catalogs and Bulletins...

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This month's FREE Literature

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

B1 **AIR HANDLING**—Also air conditioning and cleaning equipment. *Sturtevant* line. 60-page catalog 600 gives condensed specifications, application, engineering data, charts, photos. Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa.

B2 **FANS**—*Bifurcator* units for exhausting hot, flammable, or explosive gases. 12- to 48-in. diameters, up to 45,000 cfm capacity. 8-page bulletin DB-4-52 gives dimensions, photos. DeBothezat Fans Div, American Machine and Metals, Inc, E Moline, Ill.

B3 **RADIATOR VALVES**—Also radiator and steam traps, air vents. Catalog 76-H gives capacities, dimensions, diagrams of typical installations; includes a manual of temperature regulation. Jas P Marsh Corp, Skokie, Ill.

B4 **ICE RESERVE UNITS**—For process plants, dairies, bakeries, breweries, etc, where short-term heavy cooling loads occur. 4-page bulletin 152-A gives uses, specifications. Frick Co, Waynesboro, Pa.

B5 **4-CYLINDER COMPRESSORS**—For refrigeration equipment. Extra-large capacity, enclosed-construction. 16-page bulletin 651-B gives capacities, dimensions, installations. Frick Co, Waynesboro, Pa.

B6 **DEHUMIDIFIER**—For stores and manufacturing areas. 4-page bulletin gives recommended humidities, describes unit. Abbeon Supply Co, 179-15 Jamaica Ave, Jamaica 32, N. Y.

BOILERS AND AUXILIARIES

B7 **PACKAGED BOILERS**—For low pressure heating and process services. 4-page bulletin 2100 describes two-pass, natural-draft waterback type. Specifications, photos. Johnston Brothers, Inc, Ferrysburg, Mich.

B8 **COMBUSTION EQUIPMENT**—For industrial oil and gas installations. 12-page catalog 52 gives condensed review of entire line. 2-page catalog 715 describes oil-atomizing inserts for standby use. Hauck Mfg Co, 134-136 Tenth St, Brooklyn 15, N. Y.

B9 **REFRACTORIES**—For firebox and other heating boilers, air-cooled and solid refractory construction. 6-page bulletin gives specifications, installation. Pilbrico Jointless Firebrick Co, 1300 Kingsbury St, Chicago 14, Ill.

B10 **DUST AND FUME TOPICS**—Periodical devoted to *Dustube* cloth tube-type dust collectors and their applications. 4 pages, illustrated. American Wheelabrator & Equipment Corp, 1054 S Byrkit St, Mishawaka, Ind.

B11 **DRYERS**—Multi-louver type for drying, cooling, processing bulk materials. 24-page book 2409 gives principles, construction, application, psychrometric charts. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

B12 **DRYER FURNACES**—Featuring unit-suspended walls and arches. 4-page bulletin 14. Bigelow-Liptak Corp, 3550 W Grand Blvd, Detroit 8, Mich.

B13 **BOILER HEADS**—And tank heads. Dished, ellipsoidal, flanged, hemispherical, oh-round, etc, types. 30-page catalog P3 gives specifications, standard sizes. Commercial Shearing and Stamping Co, P O Box 713, Youngstown 1, Ohio.

B14 **CRUSHER**—Type AC rolling ring unit for reducing coal to uniform size. 8-page bulletin gives specifications, construction, applications. American Pulverizer Co, 1349 Macklind Ave, St. Louis 10, Mo.

ELECTRICAL AND MECHANICAL CONTROLS

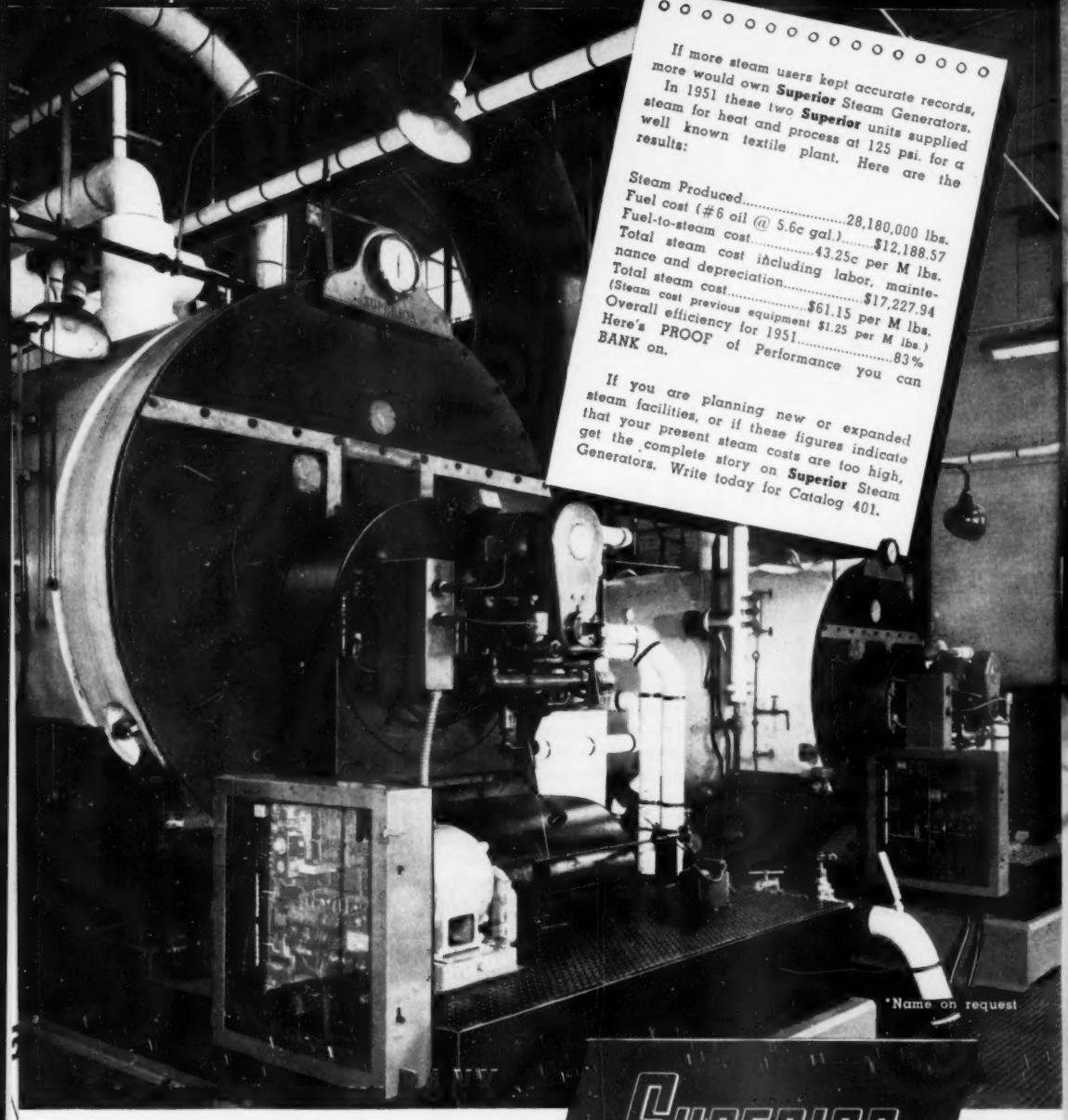
B15 **LITERATURE INDEX**—Technical material available from the Industrial div. Specification and data sheets, catalogs, etc. 36-page bulletin 100-A. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

(Continued on page 218)

accept no [illegible] of economy

LOOK at these actual STEAM COSTS

from a prominent Rhode Island Textile Manufacturer *



If more steam users kept accurate records, more would own **Superior** Steam Generators.

In 1951 these two **Superior** units supplied steam for heat and process at 125 psi. for a well known textile plant. Here are the results:

Steam Produced	28,180,000 lbs.
Fuel cost (#6 oil @ 5.6c gal.)	$12,188.57
Fuel-to-steam cost	43.25c per M lbs.
Total steam cost including labor, maintenance and depreciation	$17,227.94
Total steam cost	$61.15 per M lbs.
(Steam cost previous equipment $1.25 per M lbs.)	
Overall efficiency for 1951	83%

Here's PROOF of Performance you can BANK on.

If you are planning new or expanded steam facilities, or if these figures indicate that your present steam costs are too high, get the complete story on **Superior** Steam Generators. Write today for Catalog 401.

*Name on request

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.

SUPERIOR
STEAM GENERATORS

Photo by Ewing Galloway

Time To Get Out, Junior

THE GREAT GRAY KANGAROO of Australia is about the size of a walnut at birth. The baby is immediately attached to a "milk connection" in the mother's pouch. By early spring, Junior is large enough to reach out and eat vegetation while mother feeds. Before long, he hops out and is on his own.

And that brings me to student engineers starting out in power plants today. Most of the old engineer friends I run into at conventions and power shows tell the same story. They say the younger engineers who never worked in plants during school vacations (which I heartily recommend they do) got so used to soaking up book knowledge for almost half their life that they hate to face up to their new jobs and put their information to practical use.

Either they can't stand heat, or machinery rooms are too dirty, or working on various shifts interferes with their social life.

But I don't know of any way to learn plant operation except by pitching in and getting your hands dirty. Yet, many smart lads latch onto softer desk jobs and let the Hard Knocks graduates, like myself, do the operating, get a fully rounded experience, and finally work into the top jobs.

Don't get me wrong: I'm giving my own kids a good schooling, but they know that after years of rehearsal with books, it's time to act. That means getting in on time, taking pride in their work (regardless of how unpleasant it might be), and taking full responsibility—without leaning too much on the older operators. Like Junior, it's time to hop out and be on their own.

If they can do that, they'll be the kind of up-and-coming youngsters that make us oldsters take back those unfavorable thoughts about the "younger generation."

George Edwards

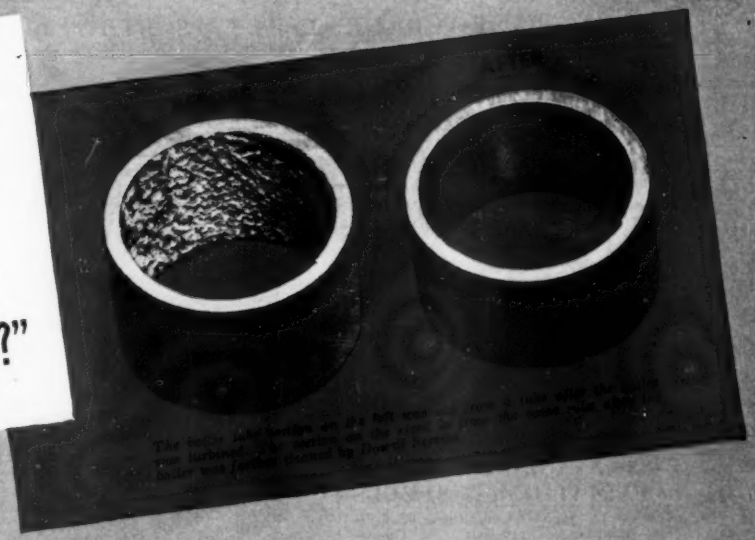
Engineer

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

A Utility asked:

"Can you help us get our boiler cleaner?"



Dowell Service removed 1,650 lbs. of deposits left after turbining

Dowell was recently called upon to clean a 150,000 pphr. boiler. In a few hours, 1,650 lbs. of deposits were removed even though the boiler had been previously cleaned by turbining!

If you have a cleaning job to be done on boilers or heat exchange equipment, look to Dowell Service. Special liquid solvents are applied according to the technique demanded by the job—filling, spraying, jetting, cascading or vaporizing. No scaffolding or dismantling is necessary—costly downtime is held to a minimum.

Dowell Service is used to clean many different types of equipment—condensers, process towers, pipe lines, storage tanks, boilers, heat exchangers, evaporators, tanks and water wells. Dowell furnishes all necessary trained personnel, chemicals, pump trucks and controls.

Dowell engineers have experience in all kinds of cleaning problems. And Dowell equipment is designed to help them do the best possible job. Call the office or station nearest you for complete information and estimates. No obligation, of course.

Other recent Dowell jobs:

6 black liquor evaporators in a paper mill were cleaned by Dowell Service. The result was a 25% more efficient use of steam.

•

2 fuel oil heaters were cleaned by Dowell Service for a sugar company. Pressure drop was reduced from 60 p.s.i. to 30 p.s.i. and temperature was increased by 40° F.

•

3 heat exchangers in a refinery were cleaned by Dowell Service. After cleaning, one unit could carry the load previously carried by all three.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Ft. Worth 2	Atlanta	Mt. Pleasant, Mich.
Boston 16	Chicago 4	Indianapolis	Hamilton, Ohio
Baltimore	St. Louis 8	Louisville	Charleston, W. Va.
Wilmington 99	Kansas City 8	Upper Montclair, N. J.	Salem, Illinois
Richmond 20	Wichita 2	Ardmore, Pa.	Beaumont, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Borger, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Midland, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Wichita Falls, Texas
Pittsburgh 19	Shreveport 69	Dearborn, Mich.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*

★ *Chemical services for oil, gas and water wells.*

DOWELL

A Service Subsidiary of

THE DOW CHEMICAL COMPANY

BIDDLE *Instrument News*

IF YOU MEASURE *SPEED* YOUR BEST BET IS *BIDDLE*

***If you want*—Readings of AVERAGE RPM or FPM...**

—choose one of the several ranges available in **Jagabi® Chronometric Speed Indicators** from 0-100 up to 0-100,000 rpm. The shaft or spindle is set in ball bearings. No lubrication needed. Design and construction of these instruments is such that a minimum of maintenance is required even in constant, severe service.

The **Jagabi Tachoscope,** stop watch and revolution counter, is also recommended for high accuracy work. **BULLETIN 35-P.**

***If you want*—Readings of INSTANTANEOUS SPEEDS or VARIATIONS in SPEEDS**

...select the **Jagabi® Centrifugal Tachometer**—speed ranges 25 to 48,000 rpm. Three—and five—ranges in one instrument . . . or the **Dr. Horn Tachometers** which are made with 6 ranges between 25 and 30,000 rpm. Both Jagabi and Dr. Horn Tachometers have a special friction coupling which minimizes the damaging effects of too fast acceleration and over-speeding. Results: Low maintenance and long, dependable service life, for direct indicating, rpm shaft or fpm linear and peripheral speeds and speed variations. **BULLETIN 35-P.**

B-812

If you want*—QUICK and ACCURATE RPM READINGS with *SAFETY

...Consider the advantages of **Frahm® Resonant Reed Tachometers** for hand use or permanent mounting.

No contact with moving parts is required. Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly. No moving parts. No lubrication or maintenance required. Accurate to ½ of 1%, they will operate continuously for years without any appreciable change. Instruments with limited ranges available for as little as $27. Practically any desired range within 900 and 100,000 rpm can be supplied. **BULLETIN 41-P.**

JAMES G. BIDDLE CO.

ELECTRICAL TESTING INSTRUMENTS

•

SPEED MEASURING INSTRUMENTS

•

LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET, PHILADELPHIA 7, PA.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.

Gentlemen:

Please send me material checked:

☐ 35-P ☐ 41-P

NAME

JOB FUNCTION

COMPANY

ADDRESS

More EQUIPMENT NEWS

Begins on page 154

OXYGEN THERAPY UNIT

P830 • *M S A Oxygen Therapy Unit* is a refinement of an oxygen demand regulator developed for high altitude flying during the war. It can be used safely to administer oxygen to victims of heart attack, heat prostration, gas inhalation and other conditions requiring oxygen promptly. **Mine Safety Appliances Co, 230 N Braddock Ave, Pittsburgh 8, Pa.**

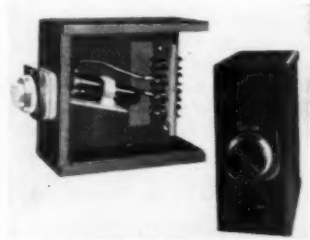
For more data on these items, use post cards, p 163. Identify request with P and number.

ENGINE PRE-HEATER

P850 • Engine pre-heating equipment that eases starting diesel or gasoline engines under severest arctic conditions. Adaptable to vehicles; for use on ships having diesels on decks or otherwise exposed; on engine-driven generators or compressors; on engines of cranes, winches or booms used for cargo handling on docks or materials handling elsewhere, or, in any outdoors location where ambient temperatures dip below "practical" engine starting temperatures.

Heating of engine interior and warming oil in engine is accomplished by circulating clean air, heated to approximately 400 F, through the engines. Lubricating oil may be heated by a heat exchanger built into or around oil sump.

Stewart-Warner Corp, 1826 Diversey Pkwy, Chicago 14, Ill.



MERCURY SAFETY SWITCH

P855 • A hermetically sealed mercury switch, mounted on a lever-operated armature for positive safety in hazardous, explosive locations. Switch is set in operation by a selector knob that inclines armature, actuating mercury switch.

Possibility of a spark is eliminated

Simplify Valve Inventories!

These "RENEWO" Valves Convert From Fullway To Plug Type!

Lunkenheimer "Renewo" Valves feature renewable and regrindable seats and discs . . . convertible from fullway to plug type. Stockroom investment and maintenance expense can be cut substantially by users who standardize on the line for all their 200-lb. bronze globe valve needs. A similar line is also available in the 300-lb. class.

"Renewo" Valves can be reground, renewed, or converted easily.

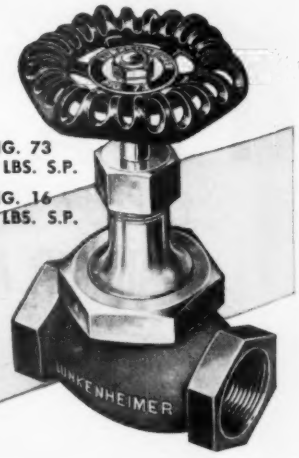
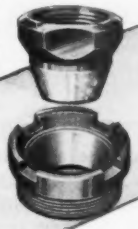


FIG. 73
200 LBS. S.P.

FIG. 16
300 LBS. S.P.

(FULLWAY TYPE) Seats and discs of hard, wear-resistant nickel alloy. Excellent for general service applications. One of the most popular valves ever designed.



(PLUG TYPE) Seats and discs of 500 Brinell Stainless Steel. Superior for severe erosive applications. Maximum resistance to effects of close throttling.

FIG. 73 PS
200 LBS. S.P.

FIG. 16 PS
300 LBS. S.P.

WRITE FOR Circular 577, which describes the "Renewo" line in detail. The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

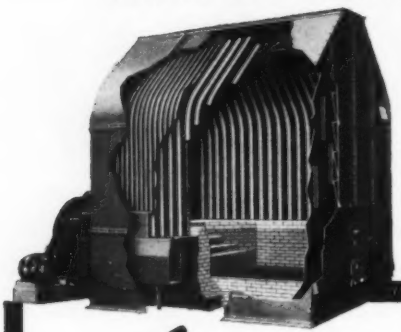
L-952-5

Specify LEE

HEATERS

for LARGE volume

MAKE-UP AIR-PROJECTS



MODEL VTH — 6,000,000 BTU 60,000 CFM. Either oil, gas, or coal fired. The finest for economically preheating and delivering large volumes for air-replacement.

Lee

Lee Space Heaters can be used in series for large air-project replacements . . . there's no heating or air replacement too large for Lee Heaters and they're so economical . . .
Lean to Lee . . . Specify Lee.

Lee Heaters for:

- space heating
- make-up air
- coal and ore thawing
- process heating
- de-humidifying, de-fogging, de-icing
- crop drying
- comfort heating — schools, churches, etc.

Complete engineering data on request for model shown and other Lee Heaters. Representatives in all principal cities.

Heaters since 1918.

LEE CORPORATION

1001 TATNALL STREET

WILMINGTON, DELAWARE

More EQUIPMENT NEWS

Begins on page 154

because of the all-mechanical nature of actuating linkage. Designed for vertical panel mounting, the new mercury switch is single-pole, with either single or double-throw action.

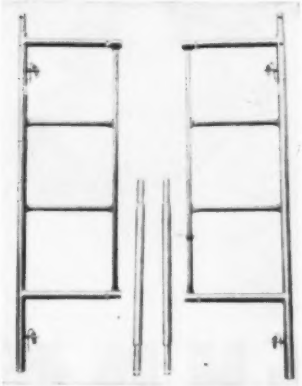
Tigerman Engineering Co, 4332 North Western Ave, Chicago 26, Ill.

For more data on these items, use post cards, p 163. Identify request with P and number.

TIME, TEMPERATURE CONTROL

P854 • Where both time and temperature control are important for product quality and efficient operation this new instrument has an integral-program cam mechanism that automatically positions the instrument control point in accordance with a predetermined program. It combines within a single case, measurement and recording on a 12-inch chart; automatic positioning of the set point index as directed by a transparent program cam; and automatic program control of the variable.

Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Aves, Philadelphia 44, Pa.



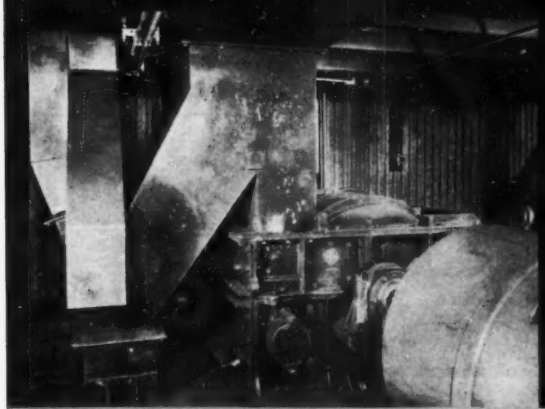
DEMOUNTABLE END FRAME

P829 • New demountable scaffold end frame, 155-X, may be disassembled and passed through small openings for scaffold erection in tanks, blast furnaces, boilers

AMERICAN CRUSHER REPORT *from Otter Tail Power Co.*

150,000 TONS LIGNITE REDUCED TO 3/4"

...Without Single Repair or Maintenance!



AMERICAN RING-TYPE CRUSHER INSTALLATION at the Otter Tail Power Co.—equipped with 150 HP direct motor drive for reducing up to 8" lump lignite to ¾" product—at the rate of 275 tons per day.

CRUSHED LIGNITE BEING CONVEYED TO STORAGE BUNKER on 408-foot Link-Belt conveyor.

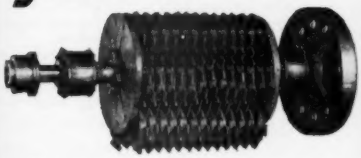
Since Nov. 18, 1950, this American AC3-C has been reducing ROM lignite and coal to a ¾" product—at the rate of 275 tons per day—for the Otter Tail Power Co., Ortonville, Minn.

This day-in and day-out performance record is notable for two reasons:

(1) Lignite, with lumps up to 8", makes up the bulk of the reduced fuel. Lignite is a tough, fibrous coal with high moisture content and a troublesome tendency to pack and cling.

(2) Not a single maintenance, repair or parts-replacement job has been necessary since installation. And the crusher is "still in very good condition with little or no indication of wear" according to the plant report.

HOW *American* DOES IT



Only American Rolling Ring Crushers have the patented manganese steel Shredder Rings that *split instead of crush* coal—resulting in a constantly uniform product with controlled fines, less maintenance and parts replacement.

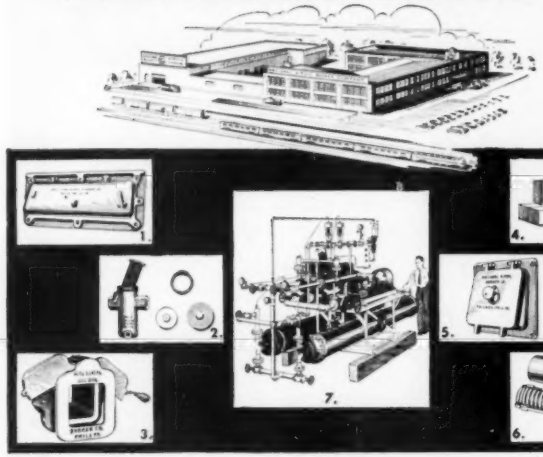
Photos courtesy Link-Belt.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave. St. Louis 10, Mo.

A Complete Line of
COMBUSTION ACCESSORIES



for EVERY
INDUSTRIAL LIQUID FUEL-GAS INSTALLATION

1. Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
2. Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
3. Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.
4. Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.
5. Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.
6. Fuel Oil Heater, Self-Cleaning, Spiral Coil type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.
7. Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps, Steam driven, Electric driven or combination Steam-Electric, with Single or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 40 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil and Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

SOUTHWESTERN DIVISION: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 154

and similar jobs where entrance space is limited. Measuring 5½ ft high and 5 ft wide, it demounts quickly into 4 sections—2 upright and 2 cross members. The largest of these are 5 ft 4½ in. long and 18 in. wide. Assembled members are held rigidly in place by coupling and toggle pins. Frame is equipped with standard *Waco Speedlock* for safety and speed of erection. Construction is of welded tubular steel.

Wilson-Albrecht Co, Inc, Dept KP, 3565 Wooddale Ave, Minneapolis 16, Minn.

For more data on these items, use post cards, p 163. Identify request with P and number.

MAGNET FIXTURE FOR ULTRASONIC THICKNESS TESTER

P819 • Economy, speed and convenience of ultrasonic thickness testing to determine corrosion, etc, is improved by this magnet attachment that magnetically clamps searching unit to hard-to-get-at surfaces, such as tank bottoms and sides. Fixture consists of a flat spring with an *Alnico* permanent magnet coupled flexibly to each end, plus means for attaching the searching unit easily to its center.

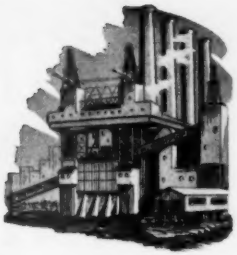
Standard magnets will clamp to slightly irregular or thinly painted surfaces. Stronger magnets are available for cast iron and other rough surfaces, or for plates with thick paint or scale. The standard fixture is only 5 in. wide, weighs 6 oz.

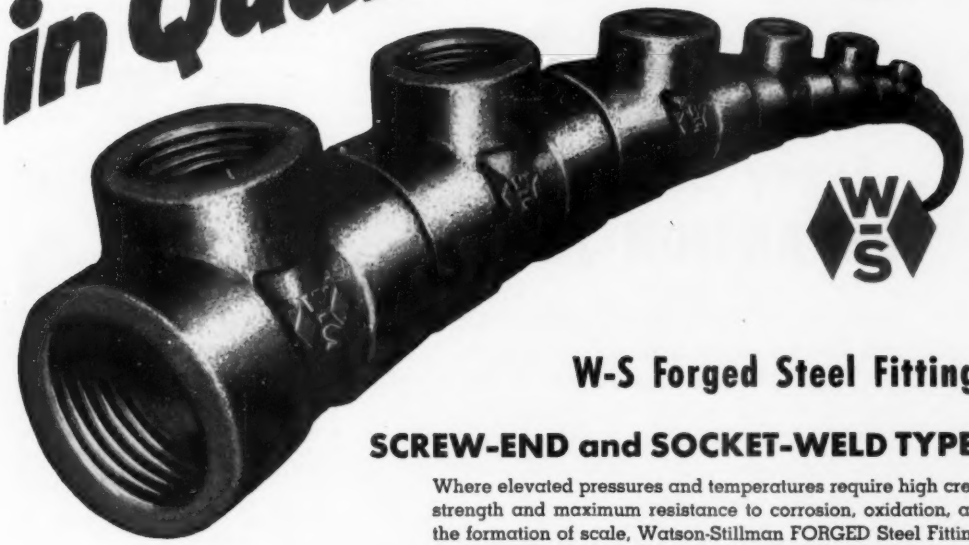
Brauson Instruments, Inc, 430 Fairfield Ave, Stamford, Conn.

SURFACE PYROMETER

P842 • *Pyro* surface pyrometer is available with a selection of 14 different thermocouples and extension arms to meet every surface and sub-surface temperature measuring problem. Thermocouples are inter-

Quality... in Quantity





W-S Forged Steel Fittings

SCREW-END and SOCKET-WELD TYPES

Where elevated pressures and temperatures require high creep strength and maximum resistance to corrosion, oxidation, and the formation of scale, Watson-Stillman FORGED Steel Fittings deliver the *strength* for *Power* . . . keep equipment on the line to greater operating economy and higher profits.

Quality—in Quantity—has earned and sustained the Watson-Stillman position of first-to-see when industry seeks a solution to a specific fittings problem. Despite an enormous increase in the use of its low *service* cost fittings, Watson-Stillman has never relaxed its concern for the metallurgical aspects of product development.

First to identify itself with the establishment of standards for the properties of special purpose fittings alloys, Watson-Stillman technicians continue in close association with the engineering research efforts of a score of basic industries . . . will be glad to lend a hand on your next fittings problem.

9-M-3

• **Stronger** • **Smaller** • **Lighter** • **Tighter**
• **More Uniform** • **Lower Service Cost**

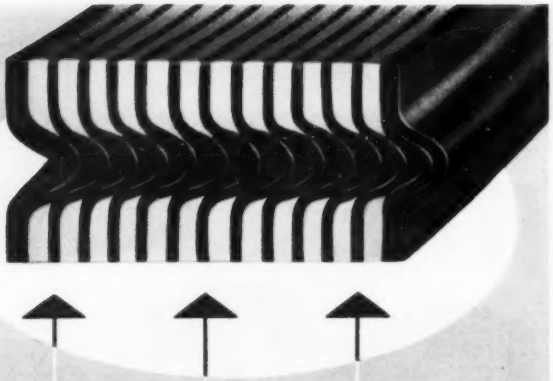
SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

DISTRIBUTOR PRODUCTS DIVISION

ROSELLE, NEW JERSEY

WATSON-STILLMAN
ESTABLISHED 1848

Designers and Manufacturers of Forged Steel Fittings, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment



Every Gasket an EXPANSION JOINT

Ajax Spiral Wound Gaskets are literally just that. The live-spring action of the U-shaped metal plies—like the convolutions of tiny expansion joints—give and take with varying pipe line or boiler stresses to seal joints tight at safe bolt loads, and keep them tight under all operating conditions.

There are types and sizes for all standard flanges and for manholes, handholes and tube caps of all makes of stationary and marine boilers, waterwalls, economizers and other boiler accessories.

Materials of construction include plated low carbon steel or stainless, Canadian or Blue African asbestos or chemically inert Teflon. Sold universally through industrial distributors. Ask your supply house or write—

UNITED STATES GASKET COMPANY

FABRICATORS OF "TEFLON" & "KEL-F" FOR THE CHEMICAL PROCESS & ELECTRONIC INDUSTRIES

CAMDEN 1 NEW JERSEY

More EQUIPMENT NEWS

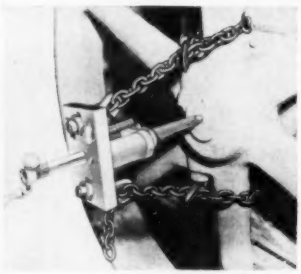
Begins on page 154

changeable without adjustment or recalibration.

Readings can be taken readily from the 4¾-in. direct-reading dial. Precise readings assured by automatic compensation feature. Instrument is shock, dust and moisture-resistant, and is available in five different temperature ranges for all laboratory and plant use.

Pyrometer Instrument Co, Inc, Bergenfield, N. J.

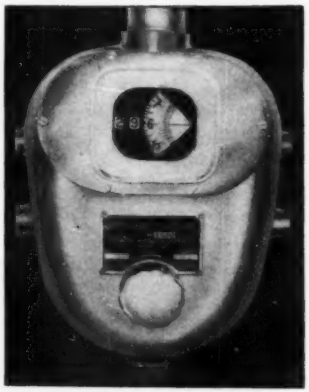
For more data on these items, use post cards, p 163. Identify request with P and number.



CHAIN PULLER

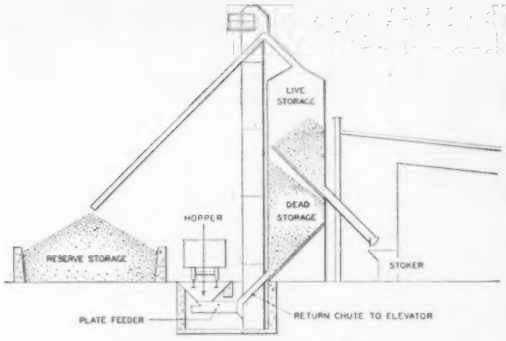
P828 • This puller operates as a two-way or three-way puller and comes equipped with 3 ft, 3720 lb proof test ⅜-in. chain with a grab hook on one end. Self centering hooks with screw adjustment permit a straight, even pull without cocking. Unit makes easy pulling of tractor wheels, pulleys, fly wheels, etc.

Owatonna Tool Co, 378 Cedar St, Owatonna, Minn.



AUTOMATIC TANK GAGE

P811 • Designated as Figure No. 2500, this automatic liquid-level gage for low pressure storage tanks incorporates full-view, direct-reading counter in the look box for quick, accurate reading of foot increments, and a dial for reading inches and fractions of tank contents. The *Neg'ator* motor housed with the gage head holds a predetermined constant tape tension, thus



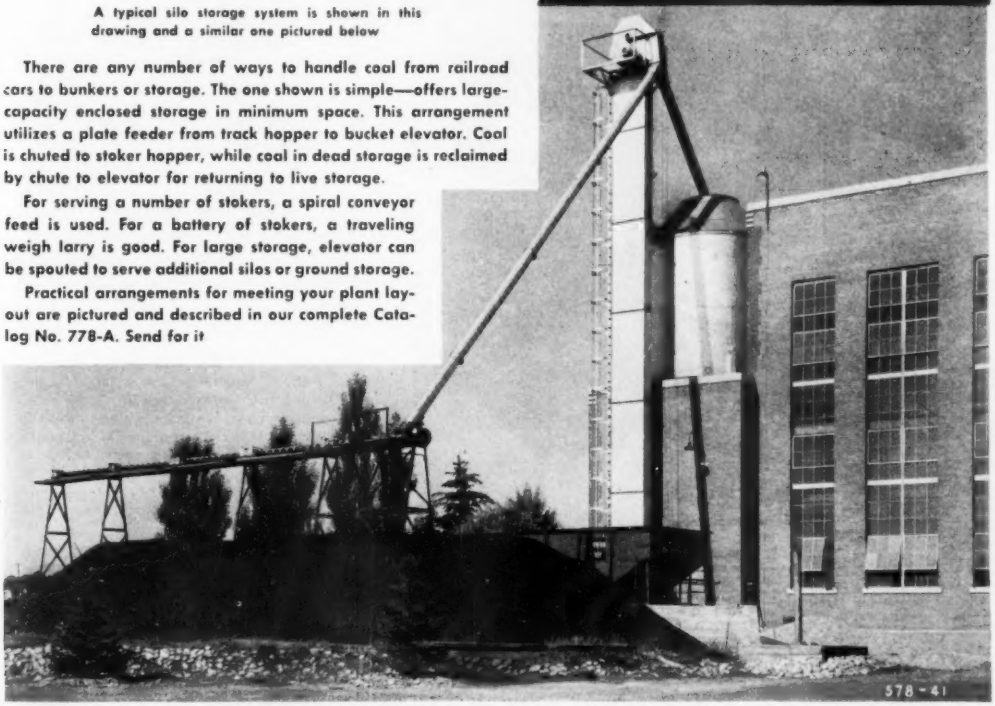
A typical silo storage system is shown in this drawing and a similar one pictured below

COAL HANDLING
From Track Hopper To Bunkers or Storage
AT LOW COST PER TON
with
JEFFREY EQUIPMENT

There are any number of ways to handle coal from railroad cars to bunkers or storage. The one shown is simple—offers large-capacity enclosed storage in minimum space. This arrangement utilizes a plate feeder from track hopper to bucket elevator. Coal is chuted to stoker hopper, while coal in dead storage is reclaimed by chute to elevator for returning to live storage.

For serving a number of stokers, a spiral conveyor feed is used. For a battery of stokers, a traveling weigh larry is good. For large storage, elevator can be spouted to serve additional silos or ground storage.

Practical arrangements for meeting your plant layout are pictured and described in our complete Catalog No. 778-A. Send for it



JEFFREY

1877 75 1952

REGARDLESS OF SIZE...

CYCLOTHERM

GIVES YOU STEAM AS YOU NEED IT

with CYCLONIC COMBUSTION!

Cyclotherm Steam Generators means *Quick Steam* when called for. This reduces fuel consumption during "coming up" periods and permits continuous, quick adjustment to load changes. The Cyclotherm Boiler is able to deliver steam faster because of its extremely high heat transfer and the fact that it has much greater water circulation since the combustion chamber is radiating heat evenly in all directions and along its entire length.

If your steam requirements have a tendency to change at different times of the day, the most economical and efficient boiler you can install is a Cyclotherm.

REMEMBER—Full power operation from a cold start in 15 to 20 minutes. Savings up to 50% on maintenance. Great fuel operational savings.

Boilers are designed for oil or gas operations from 18 thru 500 h.p., 15 to 200 lbs. operating pressure.

The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters Laboratories, Inc.

Write today for latest descriptive folder, "All Your Questions Are Answered by Cyclotherm."

CYCLOTHERM STEAM GENERATORS

DIVISION UNITED STATES RADIATOR CORP

DEPARTMENT 24, OSWEGO, NEW YORK

More EQUIPMENT NEWS

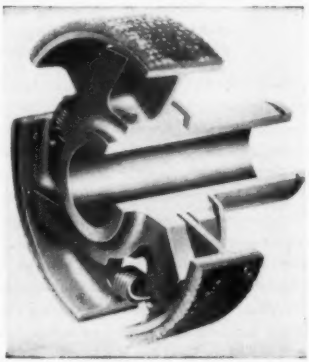
Begins on page 154

eliminating the conventional counterweight.

Additional features are: (1) adaptability to all arrangements and types of low pressure tanks to 70 ft in height, (2) gas-tight look box adaptable to existing float-operated automatic tank gages utilizing ½-in. wide tape sheaves, (3) gravity compensator allows adjustment in look box for errors due to gravity change of product, (4) optional metric measurement.

Vapor Recovery Systems Co, Compton, Calif

For more data on these items, use post cards, p 163. Identify request with P and number.



CENTRIFUGAL CLUTCH

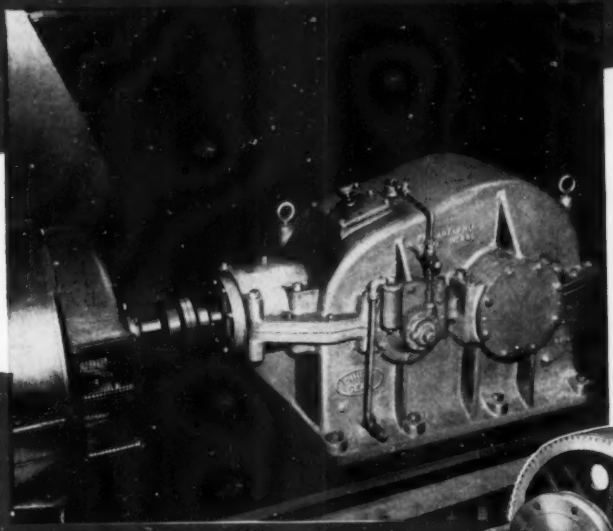
P861 • Normal speed of motor is reached before any load is picked up. When speed exceeds preset tension in springs, shoes slip out and to the rear, making contact behind the direct central impact point. Chattering is eliminated and load is picked up smoothly.

Elgin Sweeper Co, Clutch Div, 6 Oak St, Elgin, Ill.

FLOW-RATE REGULATOR

P802 • Designed for use wherever liquids are handled, this direct-acting flow-rate regulator is suited to blending and proportioning, solvent extraction, controlling filter effluent, water treatment and deion-

What features do you want in a right angle drive ?



- ☒ HIGH EFFICIENCY
- ☒ ECONOMICAL OPERATION
- ☒ COMPACT CONSTRUCTION
- ☒ QUIET RUNNING
- ☒ LONG SERVICE LIFE
- ☒ LOW MAINTENANCE

Get them all in a PHILADELPHIA SPIRAL BEVEL-HELICAL Speed Reducing Unit

The upper photo shows a Philadelphia Spiral Bevel-Helical Reducer driving a heavy duty slitter at Scovill Manufacturing Company.

For smooth, dependable transmission of power at right angles Philadelphia Spiral Bevel-Helical Reducers are in a class by themselves. Designed and built by an established leader in the manufacture of power transmission equipment, these units are made to most exacting quality standards. Every part, from housings to bearings is manufactured from selected materials and produced on modern machinery.

Both horizontal and vertical units are available in single, double and triple reduction types. Standard ratios range from 1 to 1 up to 238 to 1. Operating efficiencies are as high as 98%.

get our catalog

Complete construction details are in our catalog SB-50. Write for a copy on your business letterhead.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

When choice materials are scarce

you'll be glad you own

The New

ROTOJET®

TUBE CLEANERS

Rotojet owners can expect little or no maintenance problems during the critical times ahead. Simple design has always been a basic feature of Rotojet Motors, which have only two moving parts. That is a very important advantage, especially when quality materials for replacement parts are in short supply.

Replacement parts have always been available for Rotojet Cleaners. During our 40 years of tube cleaner specialization, prompt, efficient service has earned us the good will of our thousands of customers. To help owners of old and new Rotojet equipment to get maximum service, we have prepared a folder showing various accessories which will prolong the life and improve the performance of tube cleaners. We invite you to write for a free copy.

SEND FOR NEW ROTOJET BULLETIN

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue **Newark 1, N. J.**

More EQUIPMENT NEWS

Begins on page 154

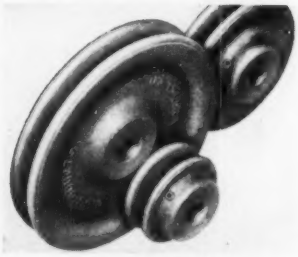
izing, chemical process control, evaporator influx, dilution of bulk heavy chemicals, etc.

To operate, set calibrated dial to desired flow rate. Regulator automatically holds flow to set rate despite pressure fluctuations in either inlet or outlet lines.

Standard capacities range from 0.1 to 100 gpm of water, accuracy is within +3%. Larger capacity and greater accuracy can be furnished. Installation requires no special tools, can be done quickly.

W A Kates Co, Deerfield, Ill.

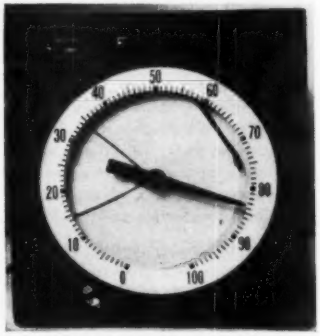
For more data on these items, use post cards, p 163. Identify request with P and number.



V-BELT SHEAVES

P862 • Molded V-belt sheaves are made from *Compolene*, similar to material used in pressure-molded gears. They have extremely hard wearing surfaces that remain unaffected by moisture, oil, temperature. Sheaves are stocked in sizes from 2 to 6 in. OD, in gradations of ½ in. Bore sizes are ½, ⅝ and ¾ in., with or without keyways.

W C Products, Inc, 1748 Berkeley St, Santa Monica, Calif.



LIQUID LEVEL CONTROL

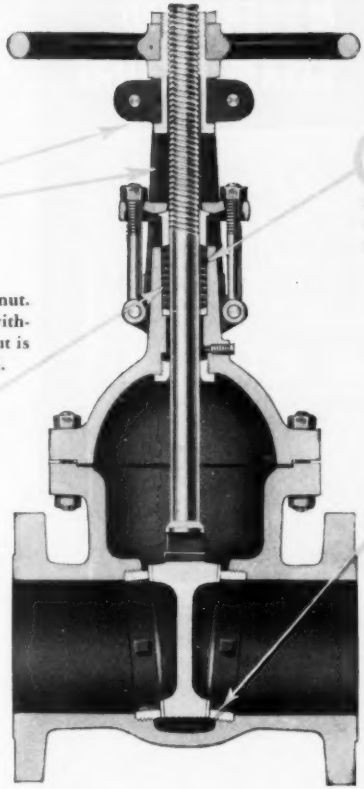
P853 • *Electronik* inductance bridge receiver combines several functions in a single instrument. It indicates, records, integrates and controls flow and liquid level. Data can also be retransmitted pneumatically to a second receiver remotely located. An *Indexet* mechanism is available to reset control index from a remotely located transmitter.

Accurate to within ±0.5% full scale,

"BUILT TO THE SAME SPECIFICATION STANDARDS – I THOUGHT ALL STEEL VALVES WERE ALIKE AS TWO PEAS"

OIC BUILDS FROM THAT POINT UP

LOOK AT THESE FOUR FEATURES:



1 2–PIECE YOKE DESIGN

simplifies replacement of yoke nut. Permits replacement of yoke nut without shutting down the line. Yoke nut is OIC Alloy 40; non-galling material.

2 STUFFING BOXES

have greater depth than is specified, permitting the use of 7 to 9 rings of packing, with either wiper rings or condensing chamber below.

3 OIC'S SEAL–EVER PACKING

(exclusive with OIC) lasts 10 to 15 times longer than ordinary packing. It stops pitting and corrosion of stems.

4 SEAT RINGS

are end-seated and are subjected only to compression forces when valve is closed; no loosening of seat rings with repeated opening and closing of the valve. No open spaces to cause turbulence, accumulate dirt and hasten corrosion.

THE BEST STEEL VALVE YOU CAN BUY

This combination involving yoke design, stuffing boxes, packing and seat rings is evidence of OIC's desire to build *beyond* minimum specifications.

THE OHIO INJECTOR COMPANY, WADSWORTH, OHIO

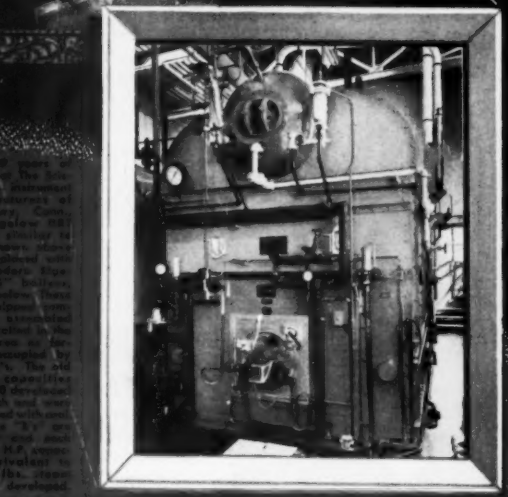
OIC FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

Type B- BOILERS BY BIGELOW

FIT INTO THE MODERNIZED STEAM PICTURE



Twin Bigelow "B's" Give The Bristol Company Modern Steam Production and Increased Capacity In Same Space As Two 39-Year Old Horizontal Return Tubular Boilers.

TYPE B FEATURES

- In many cases, sizes up to 25,000 lbs. per hr. shipped completely assembled. Minimizes field work.
- Water tubes along furnace side walls reduce maintenance.
- High efficiency with any firing method.
- Low head room. Maximum capacity for floor area.
- Will take high overloads without disturbing water level.

Write for free catalog on Type B or on any of the units listed below.

BOILERS BY BIGELOW—Water Tube Boilers—Bent Tube Types • Two-Pass Boilers Horizontal Return Tubular Boilers • Scotch Type Boilers • Electric Steam Generators

BI-9

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.
Established 1833

BIGELOW REPRESENTATIVES: Boston • New York • Chicago Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee New Orleans • Oklahoma City • Petersburg, Va. • Washington, D.C. San Francisco • Los Angeles • Seattle • Knoxville

More EQUIPMENT NEWS

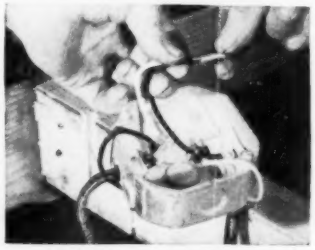
Begins on page 154

the instrument combines inductance bridge transmission system with the *Brown continuous balance system* for power positioning of pen. Easily installed in replacement of older inductance bridge receivers, the new instrument does not require any special provisions or extra equipment.
Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

For more data on these items, use post cards, p 163. Identify request with P and number.

DUCT BOOSTER FAN

P863 • Heavy-duty belt-driven fan has motor outside air stream. It can be used in heating and ventilating system, large range hoods and paint spray booths. Unit handles air at temperatures up to 350 F. Sizes from 16 to 36 in., output from 2700 to 23,000 cfm. Non-overloading cast-aluminum airfoil-type propellers develop up to 2 in. static pressure.
Chelsea Fan & Blower Co, Inc, 639 South Ave, Plainfield, N.J.



SOLDERLESS CONNECTOR

P856 • Spring-type connector that can't shake loose and requires no tools to install. *Scotchlok* electrical spring connector, provides a tight permanent splice for single- or multi-strand wires up to No. 10 in more than 300 different combinations. Made of zinc-plated steel wire in the form of a tapered coil spring, the lubricated connector is easily screwed on the stripped ends of the wires with the fingers. A notched turning stem provides adequate leverage during application and is then

LADISH

Controlled Quality

PIPE FITTINGS

maximum service assured by metallurgical soundness

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded — and certified proof of metallurgical integrity is available to users of Ladish fittings.

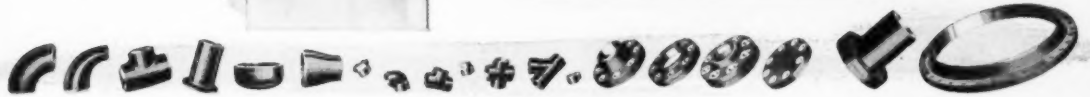
TO MARK PROGRESS

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City



PENBERTHY Liquid Level Gages

YOU CAN *Remove and Replace Without Shutdown*

Union connections between the gage and the valves permit removal of gage for repairs without shutting down the equipment. Just close the valves, uncouple the unions and remove the gage. The convenience of this is obvious. When glasses have to be replaced or repairs made, it is not necessary to work in an awkward position or to shut down. Another advantage: a gage needing repairs can be replaced immediately by a spare and the repairs made at leisure. There are many other reasons for the superiority of Penberthy Liquid Level Gages; ask for Catalog 35.

OTHER PENBERTHY PRODUCTS

PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and or temperatures. Exceptionally sturdy construction —liquid chamber machined from solid block of metal. Ask for Catalog 35.

PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.

PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS

Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

4672

PENBERTHY INJECTOR COMPANY

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

Established 1886

Canadian Plant, Windsor, Ontario

Piping for critical power installations needs more than good intentions, too. That's why you'll be wise to depend on the services of our seasoned experts for your next project. Send us your drawings for an estimate.

W. K. MITCHELL & CO., INC.
2944 Ellsworth Street, PHILADELPHIA 46, PA.
Representatives in Boston, New York, Cleveland, Mobile, Havana

WESTPORT JOINT
(PATENTED)

MITCHELL

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X-96

More EQUIPMENT NEWS

Begins on page 154

snapped off leaving a neat splice with no sharp ends.

Recommended insulation for use with the connector is plastic *Scotch* electrical tape No. 33 providing a completely water-and-oil resistant splice.

Minnesota Mining and Mfg Co, 900 Fauquier St, St. Paul 6, Minn.

For more data on these items, use post cards, p 163. Identify request with P and number.

CAULKING GUN

P820 • Pressurized *Flo Guns* handle caulking and sealing compounds, mastics and LP-2 materials on standard air line pressures or can be hand-screw pressured. Three sizes are offered: 3/10-, 1-, and 2-pints. Largest gun weighs less than 4 lb. The two larger sizes have either steel or stainless steel barrels. Disposal barrels are available with the small gun for extra sticky or fast setting compounds, eliminating time-consuming cleaning jobs. Two different types of nozzles are furnished with each gun.

Salsbury Corp, Pneumatic Tool Div, 1161 E Florence Ave, Los Angeles 1, Calif.

RATCHET REPAIR KITS

P825 • Two new ratchet repair kits for B-51 (⅜ in. sq drive) and S-51 (½ in. sq drive) *Superratchets* have been added to the Williams' line. Besides a complete assortment of replacement parts, each kit contains one special spanner wrench that fits the retaining ring (gland), the only part requiring a tool for assembly or disassembly. Printed instructions included in each kit.

J H Williams & Co, 400 Vulcan St, Buffalo 7, N.Y.

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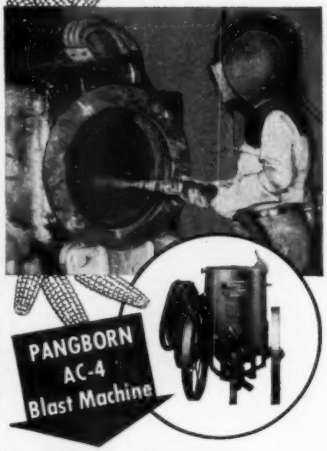

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The AC-4 uses soft, 20-mesh corncob grits to rapidly remove dirt, grease, old paint, etc., in one-third the time, and at 90% less cost than old-fashioned methods. GET FULL DETAILS . . . write, telling us what you clean, to: PANGBORN CORP., 90 Pangborn Boulevard, Hagerstown, Md.

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1. Greater wall thickness throughout—for increased structural strength.

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The built-in flexibility and long life of Badger Expansion Joints assures protection against damage to equipment by absorbing the expansion and contraction in piping due to temperature changes.

*D-F S-E Directed-Flexing Self-Equalizing: an exclusive feature of Badger Expansion Joints. The flexing of the corrugations is progressively directed over each segment of each of the all-curve corrugations by correspondingly shaped self-equalizing rings. Localized stresses are eliminated insuring a more flexible longer lasting joint.

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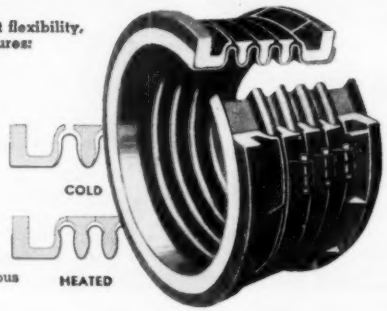
- Wide range of traverse — pressure — temperature Fabricated from deoxidized copper, stainless steel and special alloys to meet various operating conditions.



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More TECHNICAL BRIEFS

Begins on page 150

acid-sludge treatment evolves large quantities of sulfur dioxide and some sulfur trioxide. These gases are especially obnoxious when present in appreciable concentrations, and atmospheric conditions can aggravate the effect of even small quantities.

2. *Grease Manufacture:* A number of the grease-making processes use fatty acids. These may have unpleasant odors, especially when heated during processing. In addition, certain grease processes evolve hydrogen sulfide. This is the source of the "rotten-egg" odor in refineries and, in addition to being highly disagreeable, it is both toxic and inflammable.

3. *Asphalt Manufacture:* During peak summer operations the fume-disposal system was heavily loaded. The disagreeable portion of these fumes consists of hydrocarbon aerosols and vapor. The inert portion is mainly nitrogen and blanketing steam.

Studies were made of these three process sources to determine a means of minimizing the odors. Periodically pollutants were released in obnoxious quantities. But, in general, the total quantity was not excessive. The reason for this behavior was the batch nature of the processes. There were not enough pollutants to warrant consideration of economical recovery; but, on the other hand, the concentration was sufficiently high to be a potential short-time nuisance. The problem thus became one of converting the offending material into a form for satisfactory disposal.

A survey of potentially efficient scrubbing devices led to testing a device called a fog filter. This equipment was inspected in several non-petroleum applications, and it was felt that it was giving satisfactory performance in acid-fume and dust-removal service.

Essentially, the equipment consists of two cylindrical spray chambers connected by a cross-over duct. The fumes enter close to the bottom of the first chamber, pass up the cylinder in a centrifugal motion, through the cross-over duct, down the second chamber in a centrifugal motion and, finally, up and out through a central tube in the second chamber. They are drawn through the equipment by an exhausting blower on the outlet. The scrubbing medium comes in through a number of fog nozzles placed at an angle around the cylindrical chamber, so as to induce a rapid centrifugal motion of the gases. This centrifugal action disengages the fog droplets from the gases, and prevents entrainment of odoriferous mist.

A high degree of atomization of the scrubbing medium was necessary in cases of difficult gas absorption, odor,

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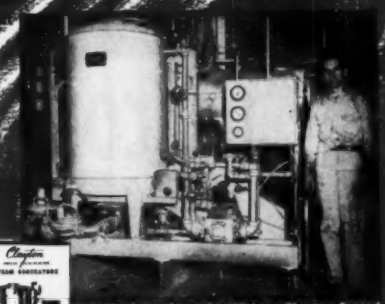

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Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

Clayton MANUFACTURING COMPANY
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More TECHNICAL BRIEFS

Begins on page 150

or dust removal. To insure this, a pump maintained 350 to 400 psi, gage, at the nozzles.

From these experimental data, it was concluded that the fog-filter type of scrubbing unit gave a satisfactory removal of the sulfur dioxide. *APSPAA paper. No number.*

Dust Collectors

Open Hearth Dust Control. *By S Vajda and G M Dreher, Jones & Laughlin Steel Corp.*

By far the greater part of the total tonnage of the steel industry is produced in open hearth furnaces. There are in this country well over one thousand open hearths varying from a few tons' capacity to over 500 tons and producing a wide variety of steels. By the nature of the operation of an open hearth furnace, dust is discharged from the stack. This dust, principally ferric oxide, is finely divided, most of it submicron in size, and is distributed over wide areas. While the appearance of an open hearth stack would indicate considerable dust being discharged, actually the total weight of dust is small. A 225-ton open hearth normally discharges about 75 lb of dust per hour, or less than a ton in a 24-hr period.

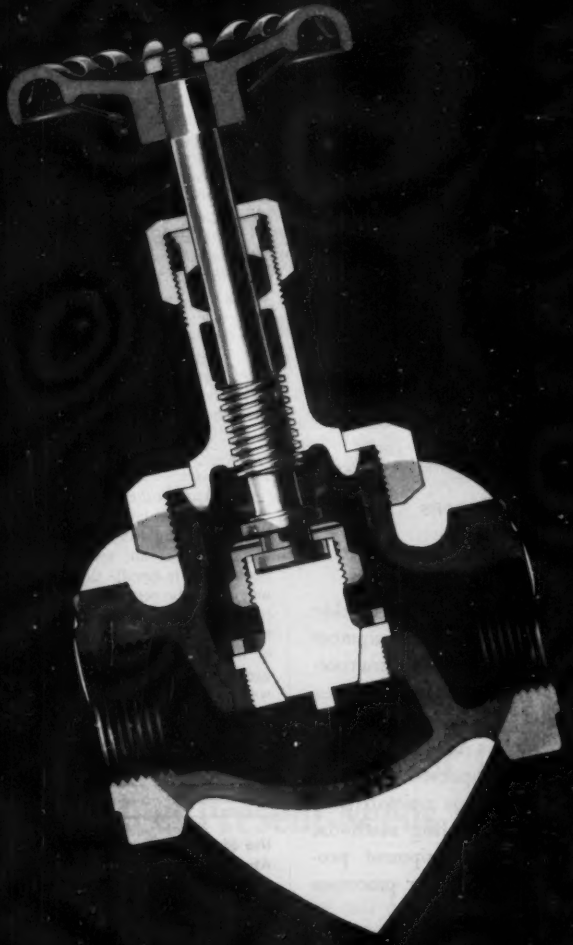
When the Allegheny Smoke Control Ordinance was written, one of its provisions was setting up a research committee of the steel companies in the county to study methods of reducing air pollution. This committee developed a standard method of stack sampling to be used by the cooperating companies and made well over a thousand dust loading tests on open hearth stacks. Especially thorough and complete was the testing at the Homestead Works of United States Steel Co.

As Jones & Laughlin Steel Corp was expanding its Pittsburgh Works production facilities by installing eleven new 250-ton open hearth furnaces, management decided to run pilot plant tests to find some practical, reasonable method of reducing the amount of dust.

Other steel companies have experimented with a high voltage electrostatic precipitator. We did not test this equipment, as their results indicated that it would do this job. But the present cost of this method of dust removal seems unreasonably high.

There are now six basic types of gas cleaning units available. (1) The bag filter that uses the fibres of a cloth bag to stop the dust particles. This causes a

Directions for ordering papers on p 152



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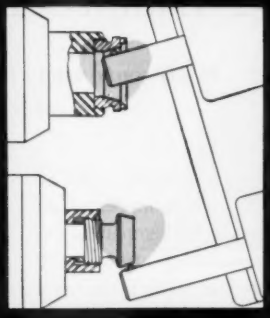
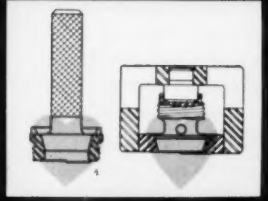


then precision gauge inspection!



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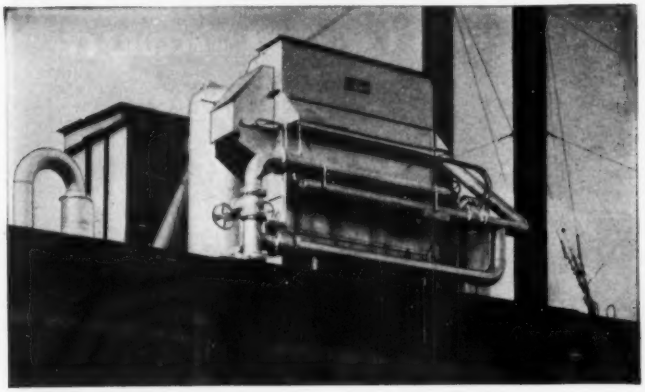

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● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

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Experienced District Engineers in all Principal Cities of U.S. and Canada

More TECHNICAL BRIEFS

Begins on page 150

layer of dust to build up and act as a filter. Bag filters are used successfully in foundries. (2) The mechanical collector that imparts a circular motion to the gases, causing dust to be thrown out of the gas stream by centrifugal force. Mechanical collectors are used on boilers. (3) The washer or scrubber that depends on high velocities to atomize the water and wet the dust particles. Washers are used to clean blast furnace gas. (4) The sonic or ultrasonic units that create sound waves in a closed chamber, causing dust particles to collide and agglomerate. Sonic units are used successfully on molybdenum oxide fumes. (5) The electrical precipitator that imparts an electric charge to the dust particles passing through its field. The charged particles are then collected on a plate. Precipitators are used on coke oven gas. (6) The pebble filter that has a bed of granular material moving transversely across path of the gases. Dust impinges on pebbles and collects on the surface and in the cracks. Pebble filters are used successfully on incinerators.

Tests run on the open hearth dust included representative units of all types except the bag filter and washer. The bag filter was not tested because the installation to handle the large gas volume would be very bulky and the maintenance would be too high. A true washer or scrubber was not tested because of the stream pollution and corrosion problems. A test was run on a modified washer with very little excess water to be disposed of. The author completes his paper with specific results of the tests. *APSPAA paper. No number.*

Directions for ordering papers on p 152

Use of Ejectors in Hydrofluoric Tail Gas Absorption. *By C R Brown and R W Tomlinson, Pennsylvania Salt Mfg. Co.*

Uncontrolled industrial fumes and vapors are objectionable for their obnoxious odors, corrosive actions on surrounding equipment, or physiological effect upon man, animals and vegetation. Generally, the best and easiest method for removing the objectionables involves intimate contact with water, other liquids, or solutions.

When we first entered the field, one of the principal problems was air pollution control and elimination.

Our stack emits a small concentration of HF (hydrofluoric) and other acids, and many methods for elimination or control were studied. One was using packed towers in which vapors were water scrubbed before discharge to atmosphere, and the effluent liquid

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...to Balance Load Factor with Low Investment
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CLEAVER-BROOKS self-contained steam boilers are the answer to both present and future steam needs. You can install Cleaver-Brooks boilers in units to fit your present steam capacity requirements . . . keeping your investment at a minimum and your boiler efficiency at a maximum. Here's how it works . . .

Your initial Cleaver-Brooks boiler installation is made in the size or capacity to fit your present steam load — this assures full use now at top efficiency and low capital investment.

As increased steam needs arise, additional Cleaver-Brooks boilers can be added to keep pace with your expanded requirements.

With this flexible program, you have the greatest return from your boiler investment — minimum original cost and lowest operating cost. Your boilers are always operating at maximum efficiency (80%) over the entire working range (30 to 100%).

Cleaver-Brooks self-contained boilers are ideal for multiple installations because of their compactness, low headroom requirements, fast installation, automatic operation, range of sizes. Available in standard models—15 to 500 hp.; 15 to 250 psi; gas, oil or combination gas and oil fired units.

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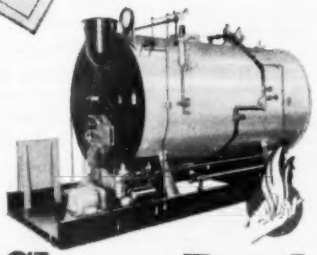

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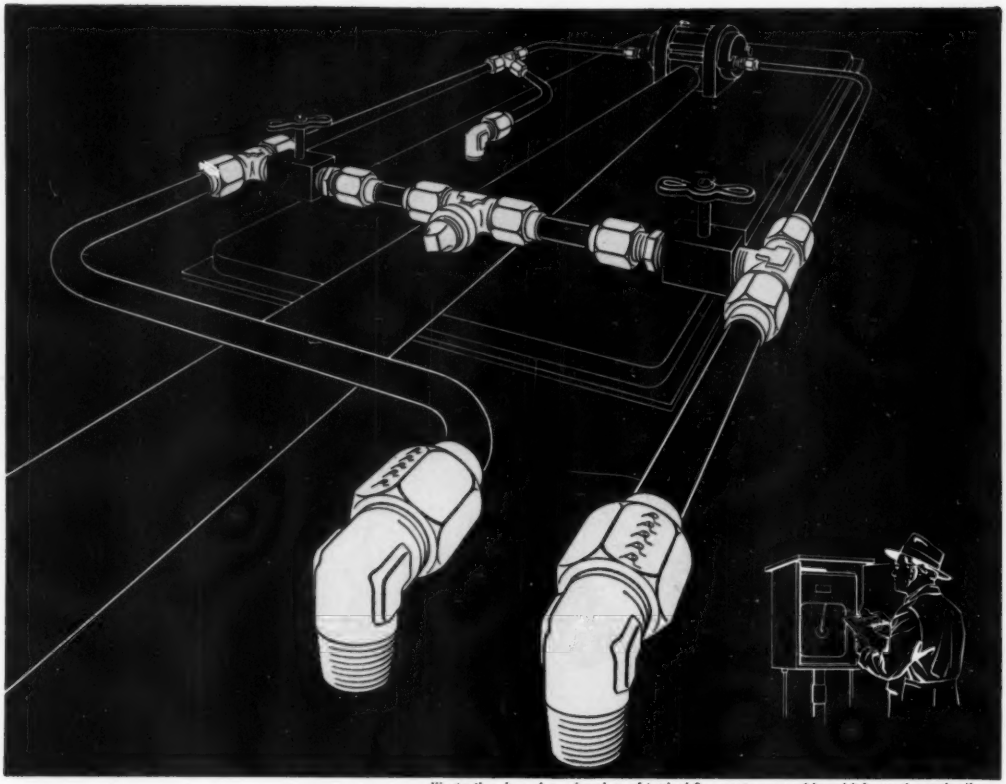

Illustration based on drawing of typical flow-meter assembly, widely used on pipelines.

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On a pipeline, for example, where many of the flow meters are located in isolated spots. Not even the smallest leak can be tolerated, because delicate instruments must register with accuracy at all times. Yet fittings must permit repeated reassembly so that meter stations can be serviced easily and quickly. And fittings must permit tube bends close to connections to conserve space.

PARKER Triple-lok Fittings — as specified by the A.S.M.E. Code for Pressure Piping and by J.I.C. and S. A. E. standards — are designed and precision made to be leakproof even under conditions of severe vibration, elevated temperatures, high pressures and repeated reassembly. That's why more and more manufacturers are specifying Triple-lok.

So *tube it up and forget it* . . . with Triple-lok Fittings. Ask your PARKER Distributor for Tube Fitting Catalog 4300, or write The PARKER Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

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More TECHNICAL BRIEFS

Begins on page 150

neutralized and sent to a waste lagoon. Many towers had to be used in series. In addition to bulkiness and expense, this installation needs mechanical transport of the vapors, has mist carryover, and the weak HF solutions are corrosive.

Another inherent difficulty is the possibility of mechanical failures causing unscrubbed vapors to be discharged to the atmosphere. One such difficulty could minimize a record of extended efficient operation materially affecting our standing in the community.

Variations of the packed tower type installation include the use of alkali solutions or recirculating acids as the scrubbing medium. When recirculating alkali solutions, insoluble or partly insoluble compounds are frequently formed and the tower may be blocked. Weak acid may be circulated countercurrent to the gas flow, particularly if the recovery of exit gas will pay for itself. This system, however, generally increases corrosion problems and mechanical failures.

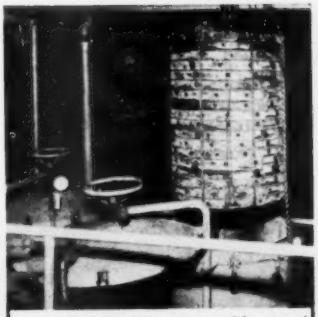
Ejectors can handle relatively large quantities of liquids and also act as exhausters. They also have the advantage of gas film break-up due to the turbulent action in the throat and there are no mechanical or moving parts that are subject to failure. Water-powered ejectors further assure an adequate supply of water for efficient scrubbing. *APSPAA paper. No number.*

Chemical Plant Air Pollution Control. *By H C Hosford, Grasselli Chemicals Dept, E I duPont de Nemours & Co.*

Our biggest problem at the Cleveland Works has been muriatic acid gas, or HCl. Even small quantities of this material on wet, humid days causes a fog, although it may not be detectable by odor.

Formerly muriatic acid was produced from salt and sulfuric acid in pot and muffle furnaces. The charge of salt and acid was worked by hand as it proceeded through the reaction and large amounts of HCl gas would roll out of the furnace doors. When a charge was completed and the salt cake residue was ready to be removed it was at about 1000 F and still contained enough reacting salt so that the gas would literally roll up in clouds when the salt cake was discharged into tram buggies to be transferred to storage. We thought we were doing very well on these systems if we got a 90% yield. Roughly 8.5% of the 10% loss was a gas loss to the air—about four and one half tons of

Directions for ordering papers on p 152



Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

How B. F. Nelson Mfg. Co. increased condensate in boiler feed 70% with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

Average oil concentration in old boilers was 65 ppm. Concentration in condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Problem: to keep oil out of new boilers. *By comparing methods, they found that filtration with Sorbo-Cel . . . a specially processed diatomite filter aid . . . did the best job.*

Sorbo-Cel slurry is fed into condensate to attract oil and hold it until it reaches filters. Sorbo-Cel collects on plates and builds up a highly porous cake. Operation is continuous until there is no more room for cake between plates—usually 70 hours.

Today, 85% of boiler feed is condensate. Labor-and-material costs are only 1.7 cents every 1000 lbs. Since B. F. Nelson produces two million pounds of steam a day, savings from reclaiming such a high percentage of condensate can readily be imagined.

For further information about Sorbo-Cel filtration mail the coupon below.

Johns-Manville SORBO-CEL

Johns-Manville
Box 60, New York 16, N. Y. POW-8

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

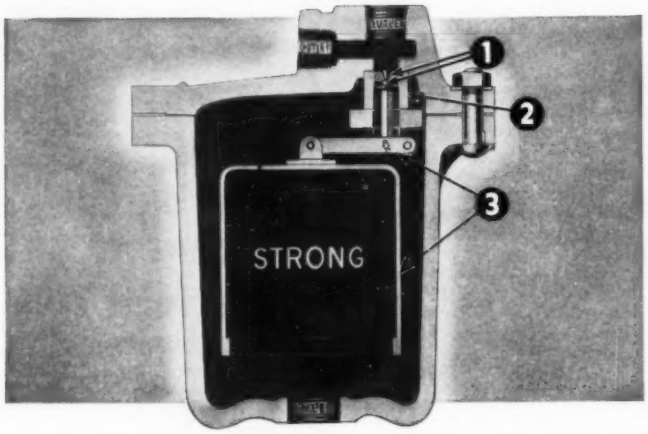
Address_____

City_____ State_____

3 Reasons

STRONG* Traps

are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-P describes inverted, open bucket and other types of STRONG traps. Write today.

*Trade Mark Reg. U. S. Pat. Off.

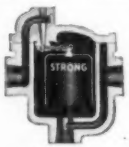
STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
Cleveland 13, Ohio

ANUM-METL
Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve



70 Series Trap

"SY" Strainer

STRONG

More TECHNICAL BRIEFS

Begins on page 150

HCl gas per day emitted to the atmosphere.

These old systems are all gone now, the last one about 1949. Muriatic acid is now produced in mechanical furnaces. At best, there is still some gas leakage at the doors of the furnace and to prevent this from escaping we have installed collecting hoods under suction from a large fan with the HCl gas absorbed in water. We get a partial return on our investment, since we take the very weak acid produced and put it over the absorption towers in the main system. Our gas loss to the air has been reduced by at least 90% or to less than one-half ton per day.

The salt cake produced on the mechanical furnace is at high temperature and it would gas readily if we did not condition it before it leaves the system with what we call a cooler-degaser. It is a water-cooled screw conveyor that receives the hot, gassy salt cake from the furnace and cools it down rapidly to a point where it won't give off any more gas. Since putting this in operation there is not a trace of gas or odor in the salt cake discharged from the cooler and it can be transported to storage without contributing in the slightest to air contamination. *APSPAA paper. No number.*

The Mechanical Type Dust Collector for Spreader Stokers. *By Philip F Best, The Thermix Corp.*

To envision a dust collector ideal for a spreader stoker, you must consider all dimensions of the dust emission, particularly those factors that influence performance of the collectors.

Ash quantity ordinarily expected to go to the stack is the first. It is influenced by the percent of ash in the coal, percent of combustible in the ash, grate areas, furnace volumes and whether or not partial or total reinjection of the ash catch is contemplated. From 20 to 50% of the ash in the coal leaves the furnace in flue gas, depending upon burning rate of the particular furnace. Entrained with this ash will be 10 to 85% combustible.

Second dimension to be considered is size. From many tests by both research organizations and industry, it is pretty well established that size of flyash from spreader stokers varies from 25 to 50% minus 325 mesh. This same size range will probably hold whether or not there is reinjection. You can logically assume, however, that with reinjection the dust would be finer than without reinjection.

The combustible in the ash ranks as

Directions for ordering papers on p 152

COVERED

WITH ADVANTAGES...

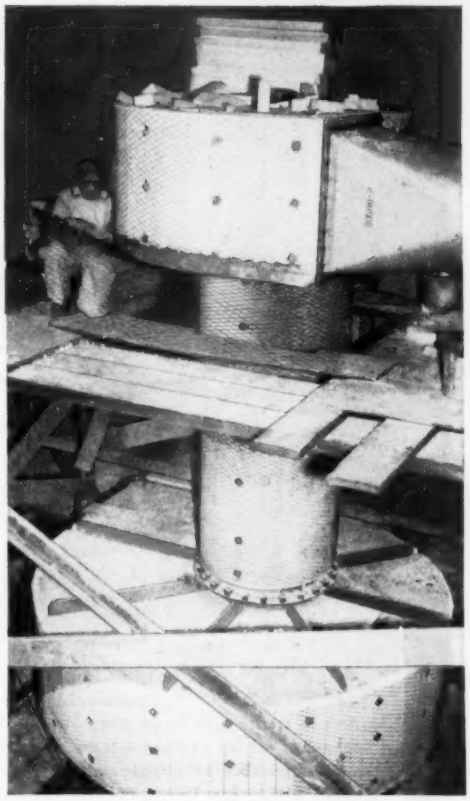
Leading Utilities Are Switching to KAYLO HEAT INSULATION

1 A Better Basic Material. Kaylo Heat Insulation is hydrous calcium silicate — a revolutionary material (not glass) developed after many years of research. Proved in thousands of field installations, it combines to a high degree the most desirable physical qualities of heat insulating materials.

2 Outstanding in Performance. Kaylo Heat Insulation has a wide effective temperature range —up to 1200° F.—thus eliminating the need for combination coverings in nearly all operating conditions. The material's unique cellular structure, composed of countless sub-microscopic dead-air spaces, provides high insulating value. It remains efficient and stable through years of service. Even when saturated with water, Kaylo Heat Insulation retains about 85% of its strength. It regains its normal strength and insulating efficiency after drying. It has high flexural strength, compressive strength and resistance to impact and abrasion. Workmen can walk on insulated equipment without causing breakage.

3 Easy to Apply. Kaylo Heat Insulation's light weight makes it extremely easy to handle and apply. The ease with which it can be cut and fitted simplifies application—saves time on the job. Breakage during installation is usually negligible. The material is non-irritating to the skin and non-toxic.

With the widest selection of sizes and shapes in the industry, Kaylo Heat Insulation reduces the number of pieces required per job. Get the complete details.



WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-276, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

NEW JUSTIN R. WHITING STEAM POWER PLANT of Consumer's Power Company located near Erie, Michigan. Included are two Babcock & Wilcox boilers with a rated output each of 690,000 lb. per hr. at 1480 psi. and 1000° F. Each boiler supplies one 85,000-kw turbine-generator for total of 170 000 kw. More than 20 carloads of Kaylo Heat Insulation are used in this installation.

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO — KAYLO SALES OFFICES: ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DETROIT HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

• High test bronze body and bonnet; nickel-alloy disc and seat ring; high tensile, high torque rolled bronze stem—plus large, deep stuffing box easily repacked under pressure—these are the features which make R-P&C Bronze semi-plug and full-plug Globe and Angle Valves outwear ordinary valves. They're fine for frequent or continuous throttling of steam, gas, oil, water. This type valve can be furnished in 200, 300 and 350 lb. pressures.

See your R-P&C distributor for information on the complete line of R-P&C valves or write nearest district office.

ACCO

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

More TECHNICAL BRIEFS

Begins on page 150

the third consideration. This is not greatly important to the dust collector manufacturer, except as it affects size and quantity of dust, but it is definitely important to the stoker manufacturer, and to the ultimate customer.

These three considerations deal with the dust itself and the problems presented by its quantity and quality. There are other considerations, however, both physical and economic. *APSPAA paper. No number.*

More POWER NEWS

Begins on page 148

efficient with this catalyst aid seem to be overlooking several basic factors. The only way of reclaiming the exhaust gas heat release is to recirculate. In most home boilers this job will not be simple. What is more, to get 100% efficiency in anything is like catching the proverbial will-of-the-wisp.

But for the process industries and especially those employing baking ovens with warm air heating, the device seems highly promising. To work, the catalyst must be raised to a temperature of 500 F. So for the starting-up stage, some form of special catalyst-preheater needs to go in. Once oxidizing begins though, and given a gas stream fairly rich in hydrocarbons, the unit will sustain combustion of room temperature gases. For every Btu per cu ft in the exhaust gas the catalyst will raise stack temperature 55 F, and through recirculation this heat can be reclaimed.

Coming Events

Sept 8-12—Seventh National Instrument Conference and Exhibit, Public Auditorium, Cleveland, Ohio. Instrument Society of America, 1319 Allegheny Ave, Pittsburgh 33, Pa. and the Industrial Instrument and Regulator Div of the ASME, 29 W 39th St, New York 18, N. Y.

Sept 9-13—Seventh National Chemical Exposition, Coliseum, Chicago, Ill. Chicago Section, American Chemical Society, 86 E Randolph St, Chicago 1, Ill.

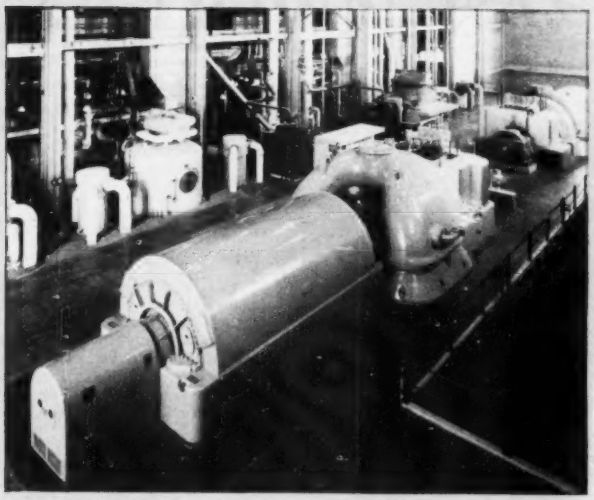
Sept 11-12—Centennial of Engineering, Chicago, Ill. Energy Symposium sponsored by ASME, 29 W 39th St, New York 18, N. Y.

Sept 18-19—East Central Section, APSPAA, Kentucky Hotel, Louisville, Ky. Acting chairman, R W Bourne, chief engr, Louisville Air Pollution Control Commission, Room 304, City Hall, Louisville, Ky.

Sept 22-24—Petroleum Div, ASME, Hotel President, Kansas City, Mo. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

(*Continued on page* 198)

"Through performance alone... inhibited turbine oils have won preference among major utility operators"



... and here's why so many of them choose SHELL TURBO OIL

Shell Turbo Oil exceeds every accepted specification for premium turbine lubricants. These are the notable qualities:

1. HIGHEST ATTAINABLE RUST PROTECTION

An effective *combination* of rust inhibiting additives goes to work at the source of rust formation. Rust problems are reduced to the very lowest level.

2. COMPLETE OXIDATION STABILITY

The anti-oxidant in Shell Turbo Oil has so far defied improvement! It provides outstanding oxidation stability and thereby minimizes sludge formation.

3. ANTI-FOAMING

The anti-foam agent used is so effective that air entrainment can be tolerated for considerable periods—avoiding unscheduled shutdowns.

4. EXCELLENT EMULSION CHARACTERISTICS

Shell Turbo Oil's remarkable protection against rust and oxidation is attained with the minimum tendency to formation of water emulsions in service.

5. PROTECTION AGAINST WEAR

The inhibitive agents in Shell Turbo Oil *add* to the wear-reducing qualities of the specially refined oil itself, an extra margin of safety for the bearings during critical starting periods.

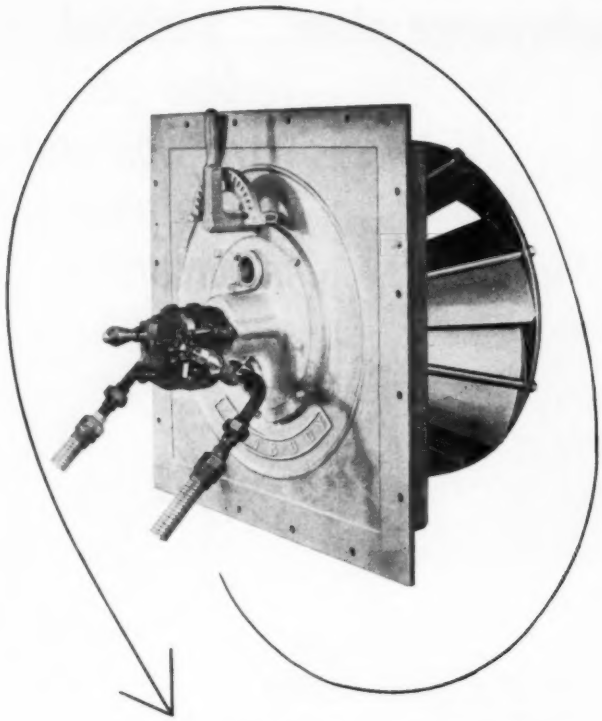
We'll be glad to give you the full story on Shell Turbo Oil, with specific recommendations for your own generating units.

SHELL OIL COMPANY

50 West 50th Street,
New York 20, New York,
or 100 Bush Street,
San Francisco 6, California.

SHELL

SHELL TURBO OIL



if efficient combustion is important...

look to PEABODY

The same principles of design that have made Peabody Oil and Gas Burners the standard of excellence the world over are also available in Peabody Combined Burners for gas, oil, pulverized coal, and other types of fuels.

If you have a combustion problem that requires a custom-engineered solution and maximum efficiency, call your nearest Peabody representative or write us direct. No obligation.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N.Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers

OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W.1, ENGLAND

More POWER NEWS

Begins on page 148

Oct 19-24—Annual Meeting American Welding Society, Bellevue-Stratford Hotel, Philadelphia, Pa. J G Magrath, secy, AWS, 33 W 39th St, New York 18, N. Y.

Oct 30-31—Fifteenth Joint Meeting, ASME Fuels Div, American Institute of Mining Engrs, Philadelphia, Pa. O B Schier, meeting chairman, ASME, 29 W 39th St, New York 18, N. Y.

2.5 Mile Conveyor From Coal Mine to River

A rubber conveyor belt system stretches more than two and a half miles through mountains in the Kanawha River Valley, near Charleston, W. Va. It carries coal destined for a large steam generating plant now under construction at Glasgow, W. Va.

The first section, 1200 ft long, picks up coal from a drift mine 500 ft up on a mountainside, slopes down 296 ft at a 17-deg angle. Then the beltroad goes across country for 4000 ft, circles a second mountain for 4700 ft, tunnels 4000 ft through a third mountain. At Montgomery, 14,000 ft from the start, it discharges the coal into river barges.

The entire system has 9 sections of rubber belting, with pulley to pulley distances from 230 to 3770 ft. At transfer points coal discharges automatically from one belt to the other.

The first (downslope) belt is 42 in. wide, cord-reinforced, handles 350 tons an hour. The eight other belts are 36 in. wide, can handle 550 tons an hour. There are 9 drive motors with a total capacity of 550 hp, but the belts need only 263 net hp to move the coal from mine to river.

Pump-Turbine Model Tests Completed

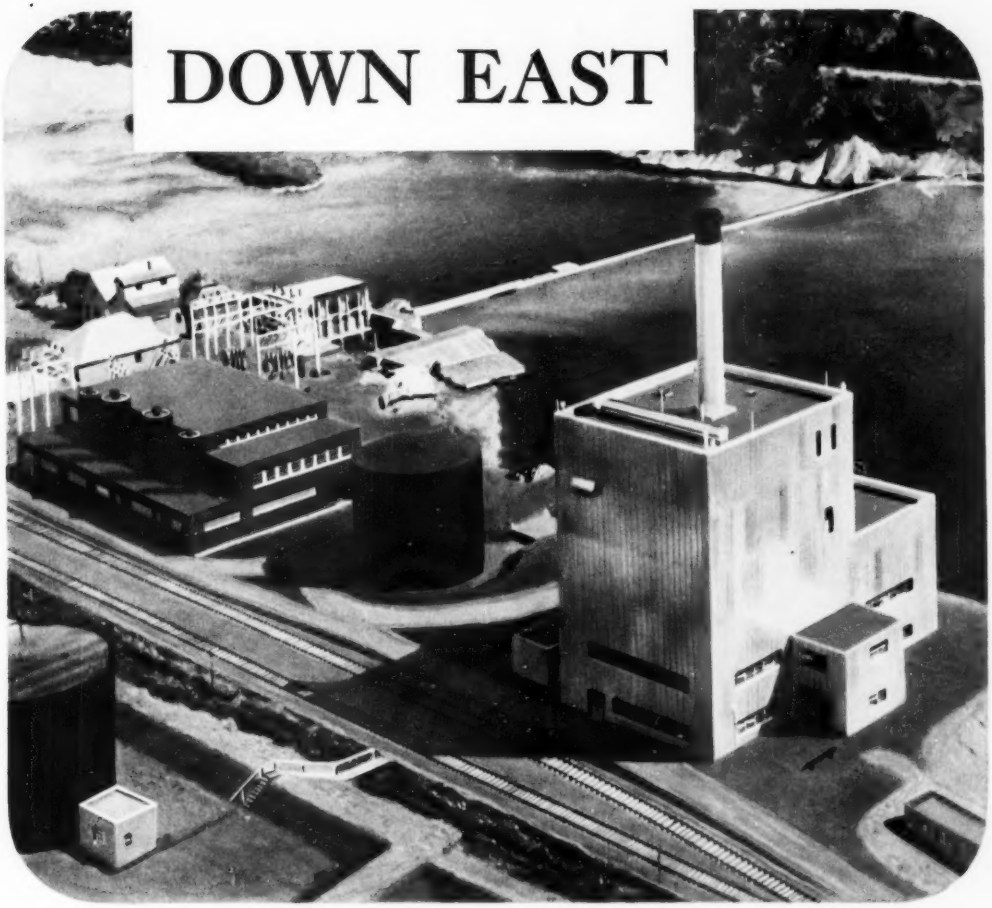
Model tests have been completed on a reversible pump-turbine that Allis-Chalmers Mfg Co is building for the U.S. Bureau of Reclamation, according to W J Rheingans, manager of Allis-Chalmers hydraulic section. It will be used at the Flatiron power and pumping plant on the Colorado-Big Thompson project near Loveland, Colo.

The reversible unit is primarily for irrigation. It will pump water from the tail race of the Flatiron power plant into the Carter Lake reservoir. When not used for irrigation, it will operate as a turbine and supply peaking power to the electrical system in northern Colorado, Wyoming and western Nebraska.

Its pumping rating is 370 cfs at 240 ft dynamic head; it will be used over a range of head from 170 to 300 ft. As a turbine, it will generate about 12,000 hp at 290 ft head, and will operate from 290 down to 140 ft head.

The unit is unique in that it will run at 300 rpm when pumping and 257 rpm when generating power, and the motor that drives the pump will also serve as a synchronous generator. It is scheduled to begin operation in 1953.

DOWN EAST



Caribou Steam Power Station of the Maine Public Service Company in Caribou, Maine. Normal capacity: 7500 kw. Top continuous load limit: 9000 kw.

This plant is a typical example of Stone & Webster Engineering Corporation's current work in the design and construction of smaller plants for power purposes.

Our services are available for power projects both large and small.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

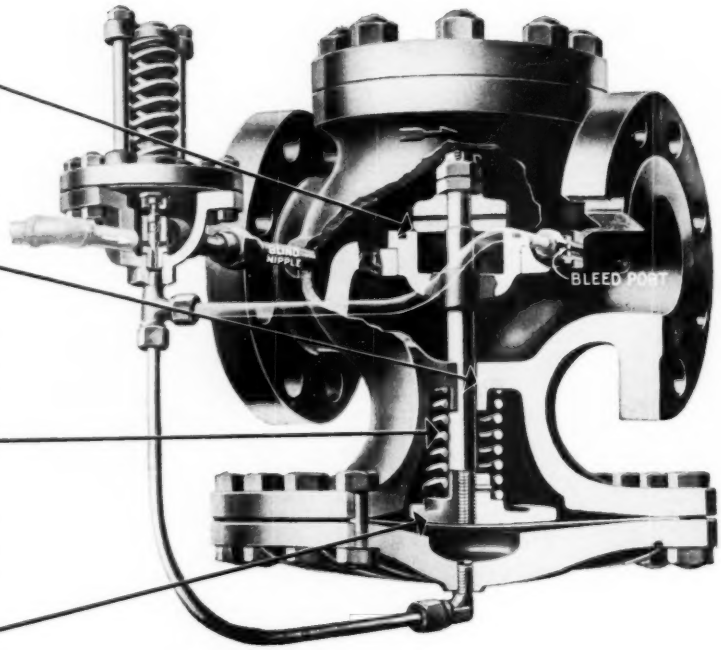
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator — operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

ACCURACY — You can be sure of accurate control for the life of the regulator.

MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

8E-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

Cut the costly excess . . . with Pure Oil Industrial Lubricants

In the complete line of high-quality industrial lubricants Pure Oil makes, you will find many oils and greases designed to do several *different* jobs, instead of one specific job.

And to do each job *equally well.*

This makes it possible for you to do *all* your lubricating with *fewer* lubricants. In other words you can

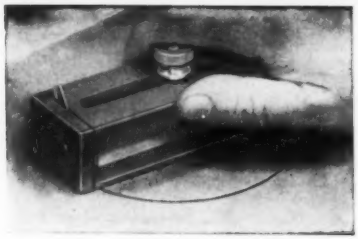
simplify and save...with Pure Oil Industrial Lubricants

If reducing your lubricants inventory would help reduce your costs (and don't you think it should?), write for full details to: The Pure Oil Company, Industrial Sales, 35 East Wacker Drive, Chicago 1, Illinois.

THE PURE OIL PURE COMPANY, U.S.A.

Be sure with Pure

ALLPAX
GASKET CUTTERS



BE PREPARED FOR ANY EMERGENCY . . . NOW!

Keep one of these ALLPAX precision tools handy in your plant . . . and save hours in meeting any emergency as it arises, quickly, safely and economically.

ALLPAX GASKET CUTTERS cut gaskets accurately from such materials as felt, rubber, cork, compressed asbestos sheet, etc. up to 3/4" in thickness. Cutter comes complete in metal case with six extra cutting blades and 18" cutting board.

TWO TYPES AND SIZES

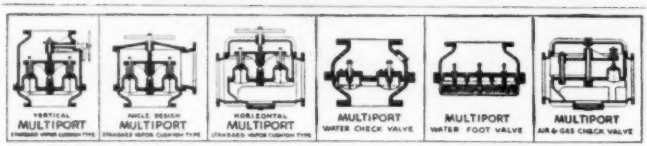
The Cutter shown cuts gaskets from 1/4" to 48" diameter. A "Junior" size cuts gaskets from 1/4" to 6" diameter.

ALSO: Packings for all services; Packings to order for Special Services; Valve Discs; Retainer Packing; Molded and Mandrel; Cut Packing Rings; Packing Hooks.

SEND FOR: a copy of the complete ALLPAX Catalog. Get in touch with your nearest distributor or with us direct for your requirements.

THE ALLPAX COMPANY INC.
805 Mamaroneck Ave., Mamaroneck, N.Y.

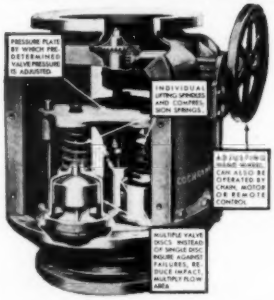
Superheat Sheet Packing . . . Oil Proof Sheet Packing . . . Red Rubber Sheet Packing . . . Diaphragm Sheet Packing . . . Cloth Inserted Sheet Packing



THE SAFE, TIGHT, QUIET MULTIPORT RELIEF VALVE

What Owners say about Cochrane MULTIPORT VALVES

"Twenty-five years of service. No other comment."
"Opened for inspection only once in 17 years."
"Opening and closing every 30 seconds with but little interruption for more than 12 years."
"This valve in service about 20 years with no maintenance."
"Savings cannot be computed. Absence of trouble is worth the price."
"No maintenance except change of springs for different pressure range after almost 15 years."
"No breakdown, no trouble, no expense."


PRESSURE PLATE BY WHICH PRE-DETERMINED VALVE PRESSURE IS ADJUSTED
INDIVIDUAL LIFTING SPINDLES AND CONTROL SION SPRINGS
ADJUSTING HAND WHEEL CAN ALSO BE OPERATED BY CHAIN, MOTOR OR REMOTE CONTROL
MULTIPLE VALVE DISCS INSTEAD OF SINGLE DISC INSURE AGAINST FAILURES, RE-DUCE IMPACT, MULTIPLY FLOW AREA

Over 15,000 Cochrane Multiport Valves in Service NOT ONE KNOWN FAILURE

Cochrane Corporation
3106 N. 17th Street, Philadelphia 32, Pa.

Please send me a copy of Cochrane Publication 4150 on Cochrane Multiport Valve.

Name.....
Firm.....
Address.....
City.....Zone.....State.....

MARMADUKE

Continued from page 142

miles downstream from Whitehorse. Ice in the lake freezes to almost four feet because of the current fanning out and slowing down under the ice.

"'We've got to find some way to get rid of that lake ice,' said the route's president, Mr H Wheeler. 'We're booked for a lot of shipping next summer. But with our short shipping season, every lost day costs us money.'

"Being a practical business man, he put me and another employee, named Bill MacBride, to work. Wheeler suggested we clean the snow off a small strip of ice that winter and experiment in melting the ice. His idea was to try various dark materials that would absorb the sun's hot rays.

"Bill and I got busy. We covered a ten-square-foot area with lampblack, another with sand, a third with black tar paper, a fourth with crankcase oil and a fifth with horse manure.

"By the end of that winter we learned that tar paper was the most effective. But it wasn't practical to cover miles of lake ice with expensive tar paper. So we had to lick that problem with what we had.

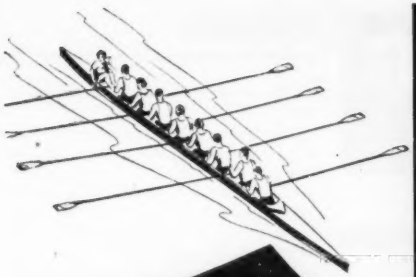
"In Whitehorse, we rounded up 2000 gallons of distilled fuel-oil and 400 pounds of lampblack. With lampblack and oil mixed, we got some help and started painting about 20 miles of ice, 30 feet wide, with brooms. That painting job started soon as the snow began to melt. But it was slow work.

"We switched to an old Model-T Ford truck and rigged a large wooden tank on her tail end. Next, we hooked up sprinklers so the oil-carbon mixture could be sprayed on the ice. But that didn't work too well until we heated the oil to help it flow easier.

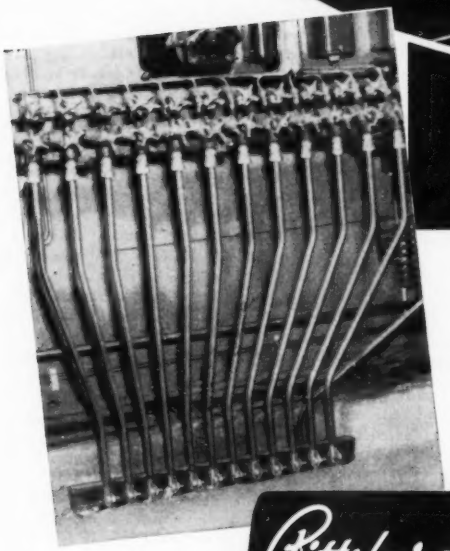
"Before long we had a 20-mile strip covered along the east bank of Lake LeBarge. And sure enough, the ice under the 'paint' started to rot after a few weeks. Before the 'unpainted' ice had begun to melt, our darkened strip had lowered about four inches. It looked like a sunken highway, chiseled into the ice around it.

"A few more weeks of hot sun and the ice under the 'paint' was thin enough to start breaking up. We then went into high gear by rigging up a barge with protecting iron sheets on her bow and sides. Pushed over the thin ice ahead of the *Casca*, I handled the throttle down below as the barge broke through the ice.

"We kept on plowing that ice until we had Lake LeBarge cleared for shipping. It added up to three full weeks ahead of time that year. But those



(S) TEAM WORK *Makes* STEAM WORK



Pittsburgh Piping GIVES SAME CAREFUL ATTENTION TO CONTROL PIPING THAT IS GIVEN TO MAIN STEAM LINES

The coxswain in a rowing scull is pint-sized — but he is the "control" that extracts smooth, flowing power from the bulging muscles of the oarsmen.

Control piping — a "small" part of a high-pressure, high-temperature system — plays an equally important part in performance. Like all parts of a P.P.&E. job — steam mains, headers and manifolds, bleed lines, etc. — it is engineered, fabricated, tested, and installed with precision.

The reason: 50 years of practice have taught us to know the tremendous importance of minute details. The result: Greater safety, smoother operation, and longer life in every P.P.&E. installation.

Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street — Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
785 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
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Heights State Bank Bldg., Houston

EVERLASTING
Boiler Blow-off Valves...

Teamed Up For "EVERLASTING" Service

The unique service qualities of EVERLASTING Blow-off Valves have long been demonstrated in boiler-rooms throughout the country. Now their superior design features have been teamed up in these new EVERLASTING Duplex Blow-off Units.

HERE'S WHAT YOU GET WITH THESE NEW DUPLEX UNITS

Sealing Valve (shown on left of unit)

- Lever- or wheel-operated types—as you desire
- Unrestricted flow — straight-through
- Rotating sliding disc—self-grinding, self-lapping
- Drop-tight seal—improving with use
- Non-wedge action — no sticking, no jamming

Blowing Valve (shown on right of unit)

- Straight-way or angle types to select from
- Strength to withstand repeated shock of blow-off force
- Exceptional resistance to erosion, abrasion and rust
- No pockets to permit lodgment of solids
- Positive action, self-cleaning

Not only do these EVERLASTING Duplex Blow-off Units provide an absolutely drop-tight seal — they are so constructed that long and repeated operation will not affect this tightness. Other Duplex Units for varied requirements are shown in our Bulletin.

Either valve of any EVERLASTING Duplex Unit can be supplied separately. But for boiler blow-off applications, any one of the complete EVERLASTING Duplex Units assures absolute safety — at low maintenance cost.

Ask your distributor — or write directly to us — for complete information.

EVERLASTING VALVE CO., 49 FISK STREET, JERSEY CITY 5, N. J.

EV 3281

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

MARMADUKE

Continued from page 202

three weeks more than paid for our trouble.

"Every schoolboy knows about dark colors soaking up more heat," roared Marmaduke, "but I doubt if anybody ever put that simple scientific fact to more practical use than we did in melting that ice. And we didn't have a lot of fancy equipment.

"That's what I mean about harnessing theory," wound up Marmaduke, hoisting himself to his feet and heading for the elevators. "I don't know of anyone who has more chances to put science to work than a power-plant engineer."

FILTRATION

Continued from page 77

They (1) give uniform distribution to incoming waters undergoing filtration. (2) collect and remove backwash water. For the latter they should be put high enough above the filter material surface so there'll be no washing away of the filter medium. Distance averages 2 ft. Maximum horizontal distance between edges of water troughs should not be more than 5 ft. Or, at least, greatest horizontal water travel should not be over 3.5 ft. Occasionally they are equipped with brass or plastic weirs to improve distribution. Never let water fall directly from a wash trough into the filter surface.

But the greater the depth of filter material, the higher the freeboard should be. Of course, size, specific gravity of filter medium, as well as wash-water temperature, influence the expansion under backwash and hence the freeboard height.

Filter Operation. One of the first rules of good operation is to establish uniform flow rates. A sudden opening of an effluent valve is asking for a "breakthrough." A rapid closing of valves can force entrained air, previously liberated from filtered water and held trapped in the bed, to burst through. There are, of course, a number of rate controllers. They range from weir and float combinations, simple butterfly or ball-float control valves to direct-acting venturi-types that contribute heavily to sound semi-automatic operation. Today you can get single control valves for full filter operation.

Next, you need rate-of-flow gages at several points—raw-water supply, each filter effluent line, main wash water, treated-water discharge. You'll find apparatus to determine loss of head through a filter bed helps establish intelligent operating control. A filter, just

"Give it the air..."

now means...cool or condense the FIN-FAN way

AIR . . . not water . . . does the cooling or condensing in a Fin-Fan Heat Exchanger.

That means freedom from all water system complications, expenses, and troubles.

But that's only one of the many Fin-Fan benefits. With Fin-Fan, you get the superior heat transfer of the exclusive K-Fin helical cooling elements that have eleven times the external surface of the same length of bare tubes, you get a unit that can be built to withstand pressures up to 5000 psi and temperatures up to 1500F, and you can handle several different duties in a single installation.

This "package type" unit may be placed in any convenient location, operates independently of wind velocity and direction, and is simple and economical to operate and maintain.

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THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-267

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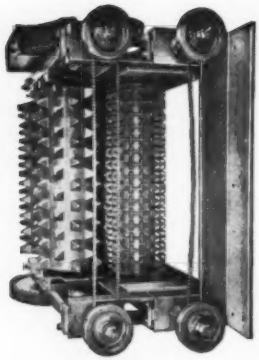
PIONEERS IN HEAT TRANSFER APPARATUS



TWO STAGE—DOUBLE ADJUSTMENT

Crusher is pictured without hopper and sprocket guards, but is delivered complete.

WRITE TODAY FOR CRUSHER BULLETIN P-3

Two Stage CRUSHING IN ONE MACHINE!

The GUNDLACH "Two Stage" Coal Crusher incorporates two crushing stages in one machine and is designed to reduce RUN-OF-MINE lix STOKER COAL in ONE operation. Compact design simplifies structural supports and installation. Rugged simple construction combined with engineering proved in the field makes this machine a profitable and reliable unit

Fulfilling an urgent need in the industry, the GUNDLACH "Two Stage" Crusher has delivered over 85% stoker coal from an Illinois mine run lot

MATERIAL SIZE CAN BE CHANGED WHILE MACHINE IS RUNNING

All Gundlach Crushers are equipped with Gundlach Patented Crushing rollers. (Pat. No. 2578540)

T. J. GUNDLACH Machine Co., Belleville, Ill.

FILTRATION

Continued from page 204

washed, shows a head differential of 18 to 20 in. It may be as low as 6 in. with relatively coarse sand as a filter bed. Maximum allowable head loss, depending on design and operating characteristics, for a fouled filter varies between 5 and 10 ft.

A good operating precaution to put in at the design stage is a water-sealed effluent line. By making sure the effluent piping is submerged at all times, no air leaks into the filter under negative pressure conditions within the tank filter.

Remember, the medium of a filter is its most important part. It requires periodic checks. If backwashing is poor (even sometimes when it is good) certain surface areas coat over with various accumulations. When you spot this you may have to cut the filter out of service, drain it, scrape the coating off by hand skimming. Left to itself this coating can penetrate into the filter bed and so foul it that flow rates have to drop and clarification suffer.

An uneven filter bed surface indicates uneven distribution of wash water. If it looks like the gravel bed has been disturbed, remove the filter medium, inspect the underdraining, repair where needed.

Backwashing is your most important maintenance tool. Use it about every 6 to 24 hr. Admit backwash slowly and run a volume roughly from 0.5 to 5% of the quantity filtered. Just how much is influenced by filter design. Well-operated plants run from 2 to 3% wash water.

WITH OUR READERS

Continued from page 5

SOME ORCHIDS . . .

Each month we ask a group of POWER readers to tell us what they think of the current issue. From their "votes" on articles, and their general comments, we derive helpful guidance in the never-ending effort to make POWER a more useful publication. Some day we'll tell you a little more about how we make this reader survey and how we use the results. Right now, we'd just like to pass along a few comments from the last batch.—*Ed.*

"*A magnificent job each month—only criticism is that it's too readable and difficult to put down. You must have a reader loyalty unsurpassed by any other technical magazine.*"—J A FALCON

"*A very helpful magazine, especially since* POWER *and* Operating Engineer *were combined.*"—WALTER SEIFERT

"*I always enjoy all the articles in* POWER. *I especially liked the article on boiler and machinery insurance, since I am an inspector for a large insurance company.*"—D E SIBERT, JR.

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GUARANTEE: *Exceeded*

SERVICE: *Excellent*

The installation: A prominent Eastern petroleum refining company.

The unit: Graver Spray-Type Deaerating Heater delivering 450,000 pounds of feedwater per hour to 650 psig waste heat boilers.

The requirements: To remove up to 100 ppm CO_2 and 12 ppm O_2 under all load conditions with water at 60°F. Guarantee - 0.005 ml/l of O_2.

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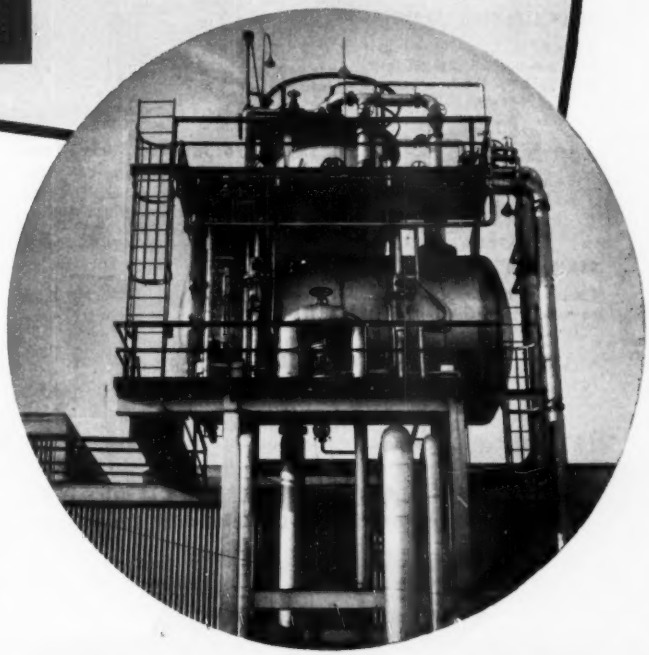

The important point about this report is that it is *typical* of Graver Deaerating Heater performance, even under difficult load variations or water conditions.

Graver Heaters are available in a *complete range* of sizes in spray, tray, or combination spray-tray types. Graver Heaters are individually tailored to your exact plant requirements . . . that's one of the reasons why Graver's guarantee and service can be depended upon.

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Division of Graver Tank & Mfg. Co., Inc.

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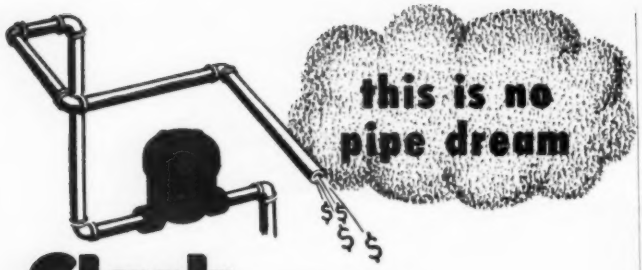

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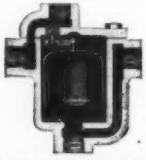

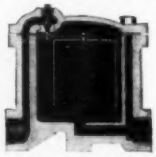

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One of the most popular in the Clark line. Continuous flow capacities up to 2600 lbs. per hour. Sizes ½", ¾" and 1". Pressures up to 200 P.S.I.

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Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.

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For continuous flow drainage. Pressures up to 600 P.S.I. Sizes ½" to 2". External discharge valve; "Clark-loy" disc and seat.

THE CLARK MANUFACTURING COMPANY
1831 East 38th St. • Cleveland 14, Ohio

THERMODYNAMICS

Continued from page 97

but $av = WV$ (23)

which gives $adv = W dV - v da$ (24)

Using this in eq (22) results in

$$dE = du + PdV - (Pvda/W) \quad (25)$$

For the flow to be nonturbulent

$$du = -PdV \quad (26)$$

Eq (25) and (26) give the energy per lb that must be transferred from the flow as

$$dE = -(Pvda/W) \quad (27)$$

From eq (23)

$$dV = (adv/W) + (vda/W) \quad (28)$$

or

$$PdV = (Padv/W) + (Pvda/W) \quad (29)$$

This shows that the elastic energy change PdV is made of two parts. The portion $Padv/W$ represents expansion work in the direction of flow. The part $Pvda/W$ is transverse or sideways expansion work. Eq (27) says that all this sideways energy must be transferred molecularly to the surrounding flow for constant momentum, nonturbulent flow to occur.

There is yet a third possibility. The momentum and energy flow can both remain constant if the turbulence increases at the proper rate. From eq (25) for both the energy flow and momentum to remain constant

$$dE = O = du + PdV - (Pvda/W) \quad (30)$$

or

$$du = -PdV + (Pvda/W) \quad (31)$$

Since

$$W = av/V \quad (32)$$

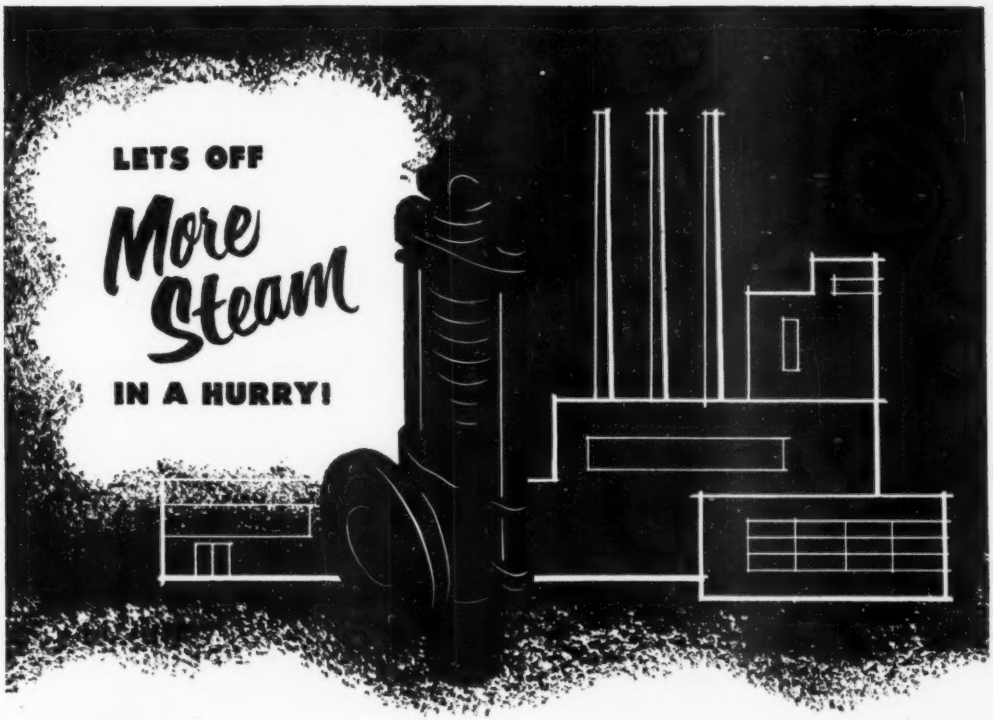
this may be written

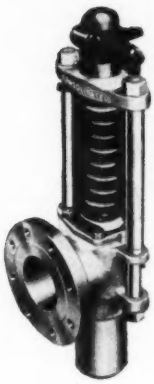
$$du = -PdV + PV(da/a) \quad (33)$$

Turbulence can increase internal energy but never decrease it. It is only $-PdV$ of eq (33) that can decrease it. Eq (33), then, is a very significant statement. *It says that the growth of turbulence can result in constant-energy, constant-momentum flow just as long as da is positive.* The expression $PV(da/a)$ is the turbulence term and only positive values of du can result from turbulence.

This means that as flow decelerates in space in front of such a device as an impact tube, the flow stream widens and da is plus. For such a situation in space where there are no solid surfaces to change momentum, the flow must be at constant momentum. However, instead of losing the energy $-Pvda/W$ of eq (27), the flow develops turbulence $PV(da/a)$ of eq (33) and thereby is able to approach the impact tube at constant energy, as usually assumed.

However, after flow reaches a region where it must accelerate and da becomes negative, it is clear from eq (33) that the growth of turbulence cannot solve the situation. The result is that in situations where solid surfaces cannot supply proper momentum changes, the flow must proceed at constant momentum. For such a case with a negative change in area $-da$, eq (27) shows that dE is positive and the flow receives energy from surrounding fluid. This would correspond to the accelerated flow following the stagnation zone and up to the maximum camber point of an airfoil or compressor blade. A point is soon reached after the maximum camber point where the flow can find a large enough positive value of area change da to develop enough turbulence to satisfy eq (33) for constant-energy flow.





Safety valves with greater discharge capacity and shorter blowdown are essential on high-pressure, high-temperature steam generating equipment. Consolidated *Maxiflow* Safety Valves release the greatest amount of steam that can flow through a given size inlet with imposed entrance conditions.

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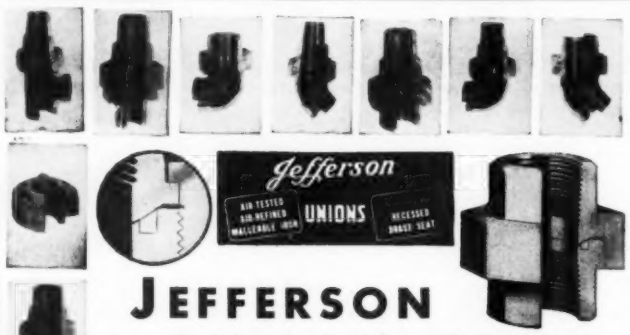

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THERMODYNAMICS

Continued from page 208

This same action can be observed in the flow around spheres and cylinders and other objects. In an airfoil the angle of the upper surface makes a great deal of difference. Full, constant-energy flow with enough turbulence to support it, requires a certain positive da in eq (33). If da is not large enough, the flow will have to be a mixture between constant energy and constant momentum with less than a full quota of turbulence.

It is small wonder that the theory of flow tubes has grown up on the idea that they must always flow at constant energy. A little thought will make it clear that most of the observation and study of flow has been in the region in front of some object placed in a flowing fluid stream. For such a situation da is plus and turbulence grows enough to permit the flow to come in at constant energy.

The only warnings that have been available that other possibilities exist have had the appearance of small, isolated discrepancies. As an example, small, nicely shaped impact tubes have failed to read full constant-energy pressures. The reason has been that in the region ahead of such a tube the flow divergence $+ da$ of eq (33) has not been great enough to prevent the transfer out of some of the energy. Note that in eq (27) a $+ da$ represents a negative energy change. Only through the careful piecing together of such scraps of evidence has it been possible to comprehend that with space flow there are two possibilities with all degrees of gradation between them. (1) Constant momentum, nonturbulent variable energy flow. (2) Constant momentum, constant energy, turbulent flow, but only when da is plus.

The molecular impacts which transfer energy through gases when constant momentum flow occurs are transverse to the flow direction. They consequently tend to produce turbulence. It is, therefore, not at all surprising that in space flow when da of the flow is positive, the turbulent, constant-energy flow occurs. It is only in space flow situations where da must be negative that turbulence will not satisfy the situation and constant momentum, variable-energy flow is observed.

The flow requirements for constant-energy, constant-momentum turbulent flow can be deduced from eq (33) which may be written

$$\frac{du}{PV} = -\frac{dV}{V} + \frac{da}{a} \qquad (34)$$

For a permanent gas such as air for which $b = 2.5$

$$\frac{u}{PV} = \text{constant} = b \qquad (35)$$

$$\text{and} \quad \frac{du}{PV} = \frac{b\, d(PV)}{PV} \qquad (36)$$

$$\text{also} \quad \frac{dV}{V} = \frac{d(PV)}{(PV)} - \frac{dP}{P} \qquad (37)$$

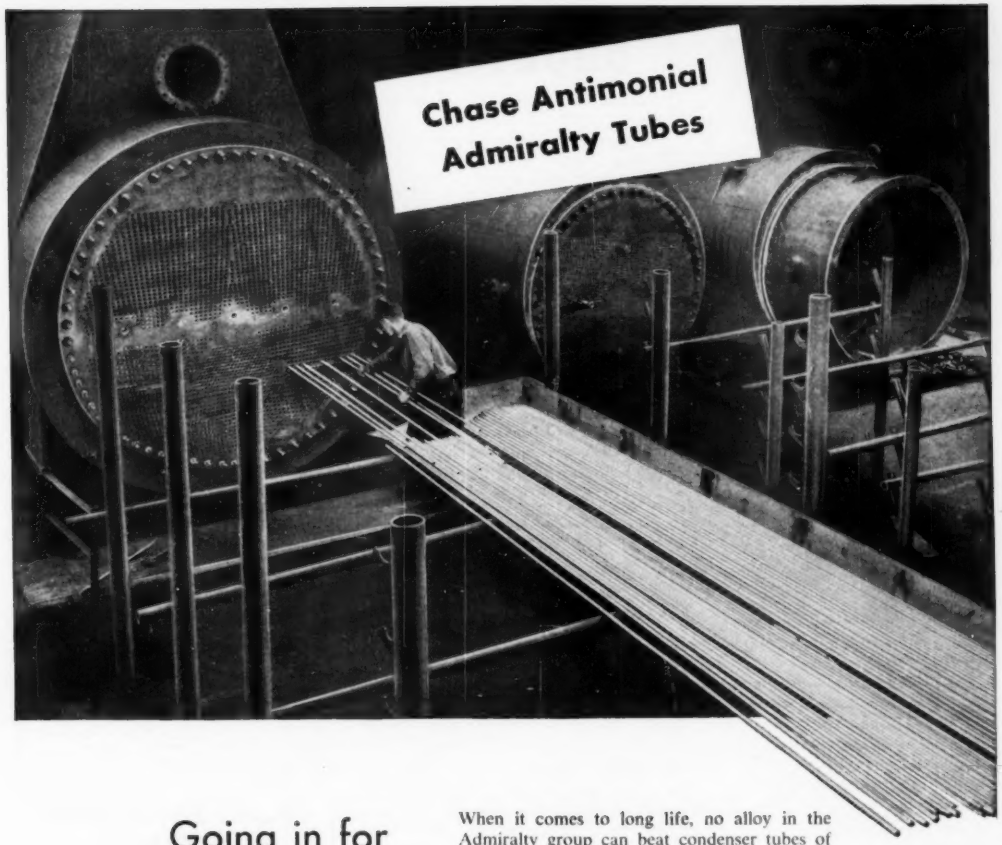
So eq (34) may be written

$$(b+1)\frac{d(PV)}{PV} = \frac{dP}{P} + \frac{da}{a} \qquad (38)$$

Integrating between states 1 and 2

$$\left(\frac{P_2V_2}{P_1V_1}\right)^{b+1} = \frac{P_2a_2}{P_1a_1} = \left(\frac{T_2}{T_1}\right)^{b+1} \qquad (39)$$

where T_2 and T_1 are static temperatures of the gas. If the flow can satisfy eq (39) constant-energy, constant-momentum space flow with turbulence can occur.



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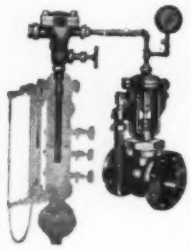

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BOOKSHELF

Primer of Electronics and Radiant Energy. (*Second edition, 1952*). *By Don Caverly, Sylvania Electric Products, Inc. 343 pp, 5½x8 in., illust, cloth. $5.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

With the release of atomic energy to peacetime projects a knowledge of the electron is more important than ever. Engineers, electricians, radio and television technicians and others find themselves in a maze of new terms, devices and applications they would like to know more about, but they do not have time to make an exhaustive study of available literature. This book gives in easily digested form information on how electrons, protons, neutrons and other atomic particles behave and are controlled and how radiant energy attending their release is utilized.

Divided into four parts the book begins with an explanation of the structure of atoms, electrons, isotopes, ions and molecules. Part II treats magnetism and electricity, bringing in descriptions of generators, motors and transformers. The largest section of the book, Part III, gives information on electromagnetic radiation, energy, light, infrared and ultraviolet radiation, radio waves, X-rays, radioactivity, atomic energy and electronic devices such as radar, loran and sonar which are being put to important uses. Part IV discusses electron tubes and various sources of radiant energy.

Many special illustrations highlight the text, among them one in color showing the radiant energy spectrum in frequencies and wave lengths from zero cycles and infinite wave length to those of cosmic rays. Anyone interested in a study of radiant energy will find this chart a valuable part of the book.

Handbook of Engineering. (*Second edition.*) *By Ovid W Eshbach, Dean, Northwestern Technological Institute,* 1324 *pp,* 5¾ *x* 8½ *in.,* $10. *John Wiley & Sons, Inc,* 440 *Fourth Ave., New York* 16, *N. Y.*

Completely revised to include developments and changes since the 1936 first edition, the new handbook features the work of 39 distinguished scientists. These men have rewritten or revised all discussions on mathematics, thermodynamics, fluid mechanics; electricity and magnetism, engineering materials, engineering law. In addition, a new section on aerodynamics stresses theory basic to design and performance of aircraft.

The engineering tables now include standard structural sizes for aluminum as well as data on tangents and offsets for the use of civil engineers. The table on standards and symbols has been brought up to date; new tables added for surveyors. The MKS system of units has been incorporated into the table of conversion factors and receives considerable emphasis throughout the edition.

(*More Bookshelf on page* 214)

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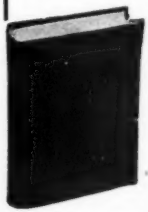
PLANT ENGINEERING HANDBOOK

Shows you literally how to run a plant today —any industrial plant—efficiently and economically. Answers questions on the economic, mechanical, chemical, and power operations in a modern plant—giving essentials of today's good practice in 76 major areas of plant operation and maintenance—an amazing compilation of data, tables, formulas, graphs, and abbreviated information for quick reference. **William Staniar, Editor-in-Chief. Prepared by more than 80 Specialists. 1955 pages, 1406 illus., 544 tables, $15.00.**



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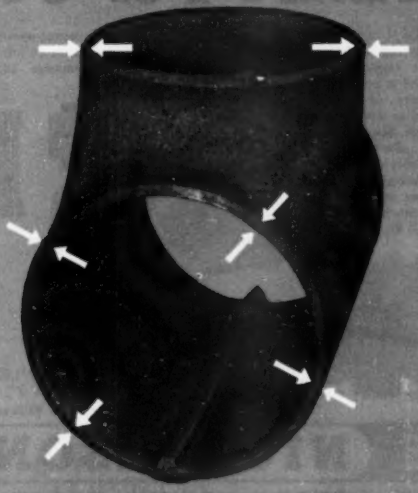
EVIDENCE OF SUPERIORITY IN *Corrosive Service*

BEFORE *Midwest 4" extra heavy weight, carbon steel tee showing original wall thickness of tee at right before it was accidentally subjected to corrosive conditions.*



AFTER *When straight pipe in line had failed from corrosion, this Midwest tee was removed. Note amount and uniformity of wall thickness remaining.*

A valve leaked or somebody opened it by mistake . . . so the Midwest Tee shown above was subjected to dilute hydrofluoric acid in addition to its normal service in a 300° F. hydrocarbon line on an alkylation unit.

The highly corrosive acid caused failure of the straight pipe . . . so the entire line had to be replaced. When cut out of the line, the Midwest Tee was found to have a considerable (and uniform) wall thickness. There was no selective corrosion and the weld held up even better than the parent metal.

This was not special alloy made to resist corrosion, but regular Grade "A" carbon steel . . . the same as the new tee shown left above. We do not, of course, recommend carbon steel for corrosive conditions, but, in emergency, it gives good account of itself.

The exclusive Midwest manufacturing process produces fittings of superior metallurgical properties. The metal is worked in compression . . . it is not stretched or extruded, and distribution is uniform. After forming and welding, the fitting is stress-relieved. For further information, write us for a copy of Catalog 48.

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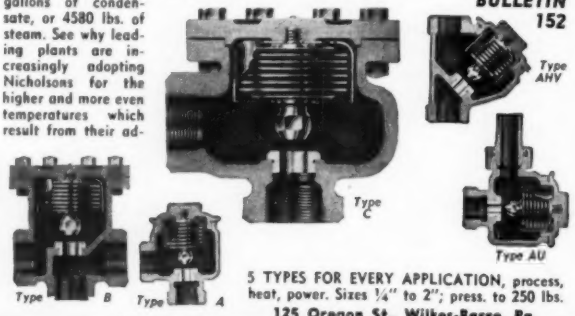
A large user of steam on the west coast reports that substitution of Nicholson traps for a mechanical type affected a cyclic saving per dryer of 550 gallons of condensate, or 4580 lbs. of steam. See why leading plants are increasingly adopting Nicholsons for the higher and more even temperatures which result from their advanced features: operate on lowest temperature differential; 2 to 6 times average drainage capacity; maximum air venting.

BULLETIN 152



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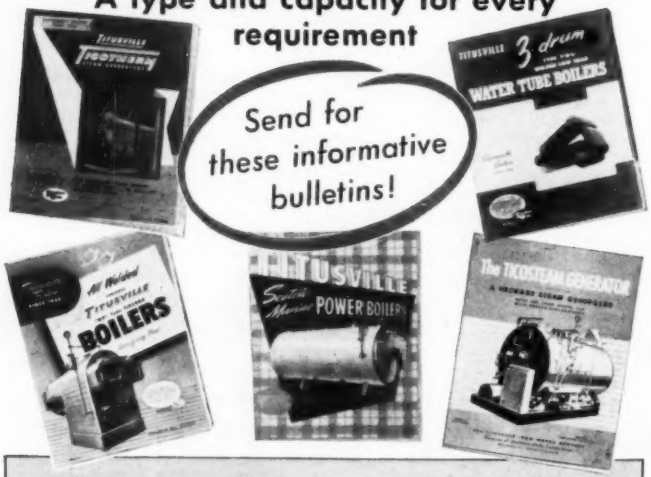

THE TITUSVILLE IRON WORKS COMPANY

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More BOOKSHELF

Begins on page 212

Standards of Tubular Exchanger Mfrs Assn. *(Third edition.)* 162 *pp*, 8½x11 *in.*, $5.50. *TEMA, 53 Park Place, New York 7, N. Y.*

Extensively enlarged with 58 more pages than the 1949 edition, the TEMA handbook conforms with current findings and conclusions of the association's technical committee. Two new sections—mechanical standards for alloy steel heat exchangers, and general information valuable to designers, fabricators and users of heat exchangers—have been added to the book.

Addition of these complete mechanical standards for alloy steel construction, Class A, makes the book much more useful and interesting to the chemical, petro-chemical and process industries. In addition, the general information section equips the 1952 Standards to serve as a single, completely self-contained reference for designers and users of heat exchangers.

Graphic Aids in Engineering Computation. *By R P Hoelscher, professor of general engineering drawing, U of Illinois, J N Arnold, assoc professor of general engineering, Purdue U, and S H Pierce, assoc professor of general engineering drawing, U of Illinois. 197 pp, illust, charts, tables, 9½x6¼ in., $4.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

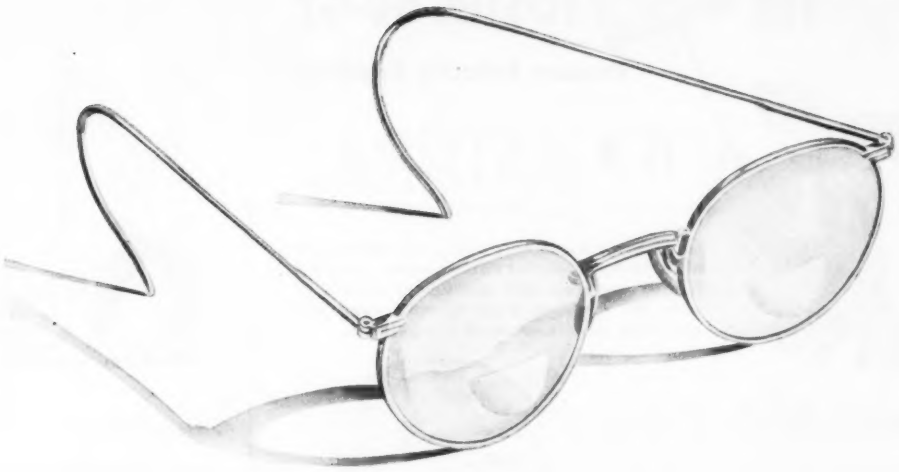
This text aims to instruct students, beyond their freshman year in college or other technical schools, in the principles of the slide rule and alignment charts. Knowledge of these tools is important to present day engineers because of their time-saving features.

The book also covers the derivation of empirical equations from experimental data. This field offers a fruitful opportunity for designing special slide rules of great utility to the research worker and engineer. A chapter on graphical differentiation and integration gives the beginner a visual and graphical understanding of the concepts of calculus. The book closes with a brief demonstration of movable-scale nomographs.

Engineering Thermodynamics *(Second edition). By Newton C Ebaugh, consulting engineer. 398 pp, 6¼x9¼ in., illust, tables, fold-out charts, $5.75. D Van Nostrand Co, Inc, 250 Fourth Ave, New York 3, N. Y.*

This book is arranged as a text for students who have had general physics, inorganic chemistry and mathematics through calculus. Four new chapters have been added to broaden the field of applications that have arisen since World War II.

The first eight chapters discuss fundamental data and thermodynamic processes and working fluids. Much material of a descriptive nature has been omitted since many schools have separate courses in the various branches of power engineering. Applications of thermodynamic theory are discussed relative to fluid flow, vapor cycles, steam engines, steam and gas turbines, gas cycles, gas compression, refrigeration, generation of heat and heat transfer.



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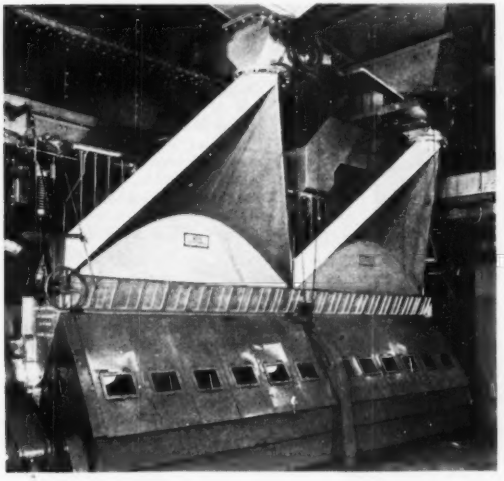

WRITE FOR NEW BULLETIN No. 73

STOCK EQUIPMENT COMPANY

745 P HANNA BUILDING,
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THE NEW FOSTER 50-G2

Pressure Reducing Regulator

IS A NATURAL

It combines extremely close regulation and high inlet-to-outlet ratio, under varying loads — approaching *instrument control* — with the freedom from trouble, long life and easy maintenance of a *regulator*.

Here's Why:

Although the new 50-G2 is single-seated for tight shut-off, it has the throttling action of a double-seated valve. Full balanced pilot valve and short travel of operating steam to the main valve piston cut the lag in response, for extremely close following of the demand. Yet overtravel, flutter and chatter are eliminated by the mass of the piston, stabilizing multi-rings, and unrestricted area under the piston.

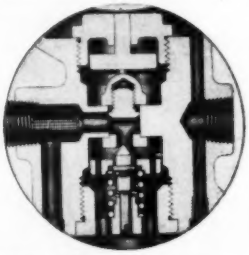
Pilot valve opening *with* the flow minimizes deadhead loss, and permits higher inlet-to-outlet ratio, for instance, 250# to 2#. May eliminate intermediate stage in low pressure applications such as deaerating water heaters, tank storage heaters and auxiliary exhaust systems.

All wearing parts are of stainless, corrosion and erosion resisting materials. New alloy metals mean less wear.

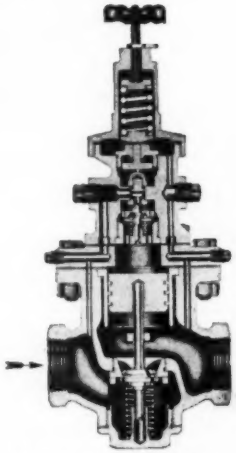
No special tools are needed servicing, and no outside media are required for operation.

Available for initial pressures 25—1200 P.S.I.G.; temperatures to 950°F; reduced pressures from controlled vacuum of 15" HG. to 600 P.S.I.G. with minor changes in top assembly; sizes ½" to 12"

For full information, ask for Bulletin G-101.



50-G2 Auxiliary or Pilot Valve Unit



Foster Type 50-G2 Internal Pilot Operated Pressure Reducing Regulator with Standard Top Assembly

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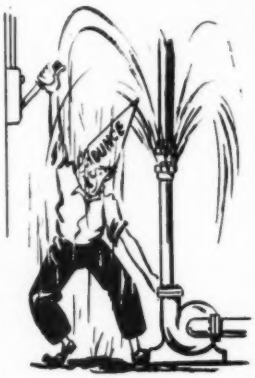
PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . CUSHION CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP Ggovernors . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SIRENS . . . SAFETY VALVES . . . FLOW TUBES



My Biggest Boner

► OUR HEATING SYSTEM supplies steam to several buildings in a hilly region. Some buildings are lower than others so we pump condensate from a receiver tank to the boiler.

One day, while in a hurry, I had to replace a leaky washer in the union on the pump discharge. I broke the union and fitted the washer in place. Just as I reached for the wrench to close the union the pump started.

Water shot to the ceiling, giving me a nice hot shower when it came down. I reached for the float switch and managed to stop the pump. Then I pulled the service switch on the wall so I could finish the job.

That's the last time I ever started work on a motor-driven unit of any type without first pulling the switch. Luckily, all I got was a free bath. But it could have been much worse if I had my hands on moving parts when the motor started.

J SHELTONS
Three Hills, Alberta

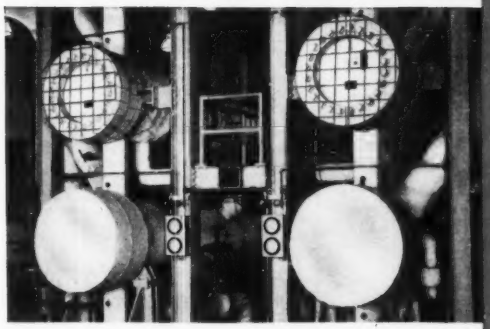
● **What is your "biggest boner"? We'll pay ten dollars for each one we publish.**

General Tire and Rubber Co plant at Baytown, Texas, solved problem of getting enough processing steam to keep production going during regular boiler overhaul by renting a Vapor-Clarkson package steam generator. This was installed in one day on a base poured the day before, will be operated for several months.

1 Evaporator Condensers
2 Closed Type Feedwater Heaters
3 Condensate Coolers
4 Jacket Water Coolers
5 Lubricating Oil Coolers
6 Evaporators
7 Oil Tank Suction Heaters
8 Fuel Oil Heaters
9 Blowdown Exchangers
10 Aircooled Heat Exchangers
11 Prefabricated Pipe
12 Propane Storage Tanks
13 Large Diameter Water Lines
14 Penstocks

check off your power plant needs

ALCO can meet them



For Example—Feedwater Heaters made by ALCO will meet your most exacting requirements because they have *all* these important features:

1. VIBRATIONLESS, TROUBLE-FREE OPERATION—support plates are of ¾ inch thickness or heavier, with tube holes drilled and reamed to a close fit and edges chamfered. Careful consideration is given to arrangement and spacing of tube supports to guard against vibration.

2. TUBE EROSION PREVENTED—alloy steel impingement baffles, one-quarter inch thick or heavier, are rigidly attached to the tube bundle support structure at points opposite the steam and drip connections to protect against tube erosion.

3. HEAT TRANSFER SURFACE EFFICIENTLY DESIGNED—tube bundles are designed to provide generous escape area and free-flowing distribution of the vapor throughout the shell space. Internal desuperheating and condensate subcooling furnished where required.

4. TIGHT JOINTS ASSURED—in all ALCO feedwater heaters, the tubes are roller-expanded into precision-drilled and reamed tube holes provided with parallel grooves. Full tongue and groove-gasketed joints are standard design.

5. CODES STRICTLY FOLLOWED—all ALCO feedwater heaters are designed and built to comply with the requirements of the ASME Code.

ALCO

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AMERICAN LOCOMOTIVE COMPANY
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***In step with tomorrow*—Alco Aircoolers, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

Mail the coupon for complete details about ALCO feedwater heaters and your other power plant equipment needs, or call your nearest ALCO Sales Engineer at Beaumont, Chicago, Dunkirk, Houston, Kansas City, Los Angeles, New York or Tulsa.

ALCO PRODUCTS DIVISION P
American Locomotive Company
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Please send me information on the following items:

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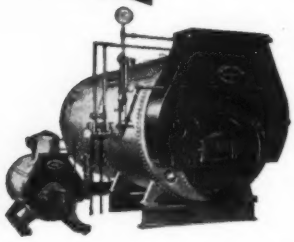
A **BOILER** With Economy

A **LEFFEL** Scotch Boiler!



Users of self-contained, compact Leffel boilers report fuel savings of from 20 to 40 percent over other types. The 17 sizes are available in ratings of from 6 to 250 *actual* horsepower. And the sturdy, dependable construction of all Leffel boilers permits substantial overloading with safety. Designed to burn COAL, GAS, or OIL, they are easily converted from one fuel to another. There is an efficient Leffel Scotch type boiler, *easy* to install, ready to go to work in your plant . . . today!

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The James Leffel & Co.
(Established 1862)

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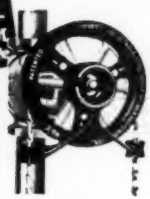
Babbitt —Adjustable— SPROCKET RIM with Chain Guide



INSTANT POSITIVE CONTROL

for ALL Overhead Valves

- Pull the chain! That's all that's needed to open or close overhead valves—for complete control from the floor! Operating action of the BABBITT Adjustable Sprocket Rim with Chain Guide is as positive and immediate as that of direct manual control —and 100% safer because the risks of climbing treacherous stepladders, or on benches, machines or boilers is completely eliminated.

- The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

- Range of 10 adjustable sizes takes care of all valve makes and types: its valve wheel diameters from 2 to 30 inches. Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
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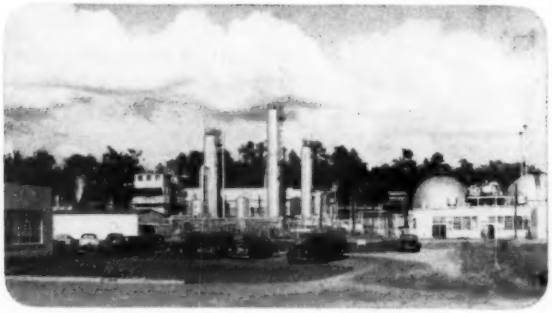
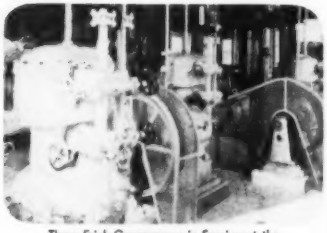


New Plant Making Agricultural Ammonia Uses Frick Refrigeration



Three Frick Compressors in Service at the Mississippi Chemical Corp.

The Mississippi Chemical Corp. at Yazoo City uses three Frick compressors to hold 2,000 tons of liquid ammonia in the spherical tanks (at upper right) by reducing the pressure and temperature.

This eight-million-dollar plant, built by 10,000 stockholding farmers, produces both liquid ammonia and solid ammonium nitrate for use as fertilizer.

Installation by Munford Engineering Co., Frick Distributors at Jackson.

For that all-important cooling job of YOURS, get in touch with

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery

More FREE BULLETINS

Begins on page 163

B16 **CONTROLLERS**—Model 40 in 8 basic types, for controlling temperature, pressure, flow, pH, conductivity, etc. 32-page bulletin 461 shows operation, controls, selection. Foxboro Co, 26 Neponset Ave, Foxboro, Mass.

B17 **RECORDERS AND CONTROLLERS**—*Speedomax* Type G instruments for temperature, speed, power, illumination, weight, etc. 48-page catalog ND46(1) has photos, characteristics, installatio s. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

B18 **CONTROLS**—Electric and electronic. 8-page selection guide GEA-5781 has quick-reference selection data, photos, lists publications with complete information on motor starters, pushbuttons, switches, etc. General Electric Co, Schenectady 5, N. Y.

B19 **TEMPERATURE CONTROL**—*Pyrotac* unit monitors up to 20 individual temperature points a minute, gives instant readings on temperature variations. 8-page bulletin shows features, construction, applications. Bulchen Co, 400 W Madison St, Chicago 6, Ill.

B20 **PRESSURE GAGES**—Indicating and recording instruments with pneumatic control. 4-page specification sheet 710 gives specifications, construction. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B21 **COMBUSTION CONTROL**—For oil-fired burners. *Eyematic* unit regulates fuel-air ratio with electric eye in smokestack. 8-page bulletin 22 gives details. Brooke Engineering Co, Inc, 4517 Wayne Ave, Philadelphia 44, Pa.

B22 **DIAPHRAGM MOTOR VALVE**—Double-seated air-operated units for wide band proportional control. 8-page specification sheet 400-4 gives sizes, construction, pressure ratings. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B23 **ALTERNATORS**—For changing starting sequence on any two pumps, compressors, blowers, burners, etc. Provide standby protection against failures. 4-page bulletin 7100 gives details. Automatic Control Co, St. Paul 4, Minn.

B24 **ALTERNATORS**—Automatically change starting sequence on 3, 4, 6, or 12 equally-rated pumps, blowers, compressors, burners, etc. Operate from float, pressure, thermal, or other pilot switches. 4-page bulletin 7110. Automatic Control Co, St. Paul 4, Minn.

B25 **BOILER WATER CONTROLS**—Feeders, low water fuel cut-offs, pressure relief valves, float operated switches, solvent still regulators, etc. 24-page bulletin SC-2 gives sizes, photos, selection data, capacities. McDonnell & Miller, Inc, 3500 N Spaulding Ave, Chicago 18, Ill.

ELECTRICAL EQUIPMENT

B26 **SQUIRREL-CAGE MOTORS**—Induction type. Drip- and splash-proof construction. Ratings ½ to 100 hp. 6-page bulletin 51B6210D gives features, dimensions, cut-away drawings. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

B27 **LARGE AC MOTORS**—Reprint of AIEE paper *Application of Large AC Motors*, by G L Oscarson. 18-page booklet 1113 discusses motor characteristics, control, selection. Charts, photos. Electric Machinery Mfg Co, Minneapolis 13, Minn.

B28 **MOTOR CASE HISTORIES**—Outstanding application of *Life-Line* motors in chemical, textile, petroleum, metalworking, machine, production tool, etc, industries. Photos, sketches. 36-page booklet B-4769. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

(Continued on page 220)

Hays Guide to Boiler Plant Results

increased efficiency

"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."

SHERWIN WILLIAMS, Chicago Plant

low maintenance

"we find that due to the (Hays) properly controlled combustion, our maintenance on both stokers and boilers has been considerably decreased."

AMERICAN TOBACCO COMPANY

fuel savings

"we estimated that . . . we would be able to pay for the new equipment (Hays Combustion Control) out of the fuel savings in three years. Since then, the records show that the amortization of the original investment has been accelerated."

RAYBESTOS-MANHATTAN, INC.

rapid response to wide load swings

"we have made test runs using the Hays system, bringing the load rapidly up from 8,000 to 80.000 lbs per hour with excellent results. Fuel-air ratio was held at the desired value and CO_2 at 15%."

BEMIS BROTHERS BAG CO.

HAYS COMBUSTION CONTROL GETS RESULTS . . . *Proof of this statement is available in the form of case histories on the boiler plant experience of 9 leading companies. These "result stories" cover small, medium, and large boilers —burning all types of fuel, including alternate fuels—with different load characteristics—and different uses for steam.*

Send us a brief statement of your specific conditions and specifications. You'll receive the case histories which fit your needs and a 48 page booklet on "Boiler Plant Instrumentation".

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
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Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders

THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

(Advertisement)

Large Power Producer Meets Demands up to 400,000 lb per hour with Evaporation Rate of 12.8

"During the many years we have been generating power at Scovill Manufacturing Company, Waterbury, Conn.," says Leo Niekerk, Power Plant Chief Engineer, "we have evolved a general philosophy for power plant operation: buy the best equipment available, then operate and maintain it in the most intelligent way possible. We have two power houses—the West Power House containing one 500 kw vertical turbine, one 3,000 kw condensing turbine generator, and two 600 hp oil-fired 150 psi boilers on standby; and the East Power House containing three 3500 kw condensing turbines, one 5,000 kw topping turbine, six 600 hp stoker-fired 250 psi boilers and, handling most of the load, two 660 psi oil or pulverized coal-fired steam generating units rated at 225,000 lb/hr and 150,000 lb/hr."

fuel handling

"Coal from railroad cars is transferred to overhead bunkers by a conveyor system. Fly ash from dust collectors is removed by conveyor ash handling system and discharged through an outside silo. Oil is stored in two 150,000 gal. tanks and fed by gravity to the fuel oil pumps in the basement."

combustion control

"When we installed our Boiler #1 in 1940 we selected Hays Combustion Control. We were so pleased with its operation during the next six years that when we installed Boiler #2 in 1946 we again specified Hays Combustion Control. Each boiler has its own Hays panel containing a complete complement of modern boiler room instruments and controls. Currently we are meeting steam demands up to 400,000 lb per hour (with load swings as high as 60,000 to 70,000 lb per hour) while achieving an evaporation rate of 12.8, a fuel cost per kw of $.0049, and a cost per thousand pounds of steam of $.706. No small part of the credit for the versatility and efficiency of our operations should go to the Hays Combustion Control System. Maintenance expense on the control system has been negligible.

The above story is a condensation of a completely illustrated case history on the power plant operation of Scovill Manufacturing Company. Write for Bulletin R-8, available free from The Hays Corporation, Michigan City, Ind.

STEAM TURBINES

TYPE UV MULTISTAGE

- Available with from two to ten pressure stages. Horsepower range from 100 to 4000, steam pressures up to 600# ga., 750°F., condensing or non-condensing. Optional governor equipment and accessories adapt UV Turbines to any mechanical drive within their capacity range.

Contact your Murray representative or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY, BURLINGTON, IOWA

MURRAY for over 75 years

Builders of Steam Power Equipment

More FREE BULLETINS

Begins on page 163

B29 **ALUMINUM CONNECTORS** — For overhead distribution service. 32-page catalog AL53 describes 18 types of electrical connectors, illustrates installation tools and accessories. Properties, ratings. Burndy Engineering Co Inc, Norwalk, Conn.

B30 **RESISTORS** — *Vitrohm* power-type wire-wound units. 7 stock types, various made-to-order types, ratings from 5 to 550 w, 0.04 ohm to 1.75 megohms. 64-page catalog 15 gives photos, specifications. Ward Leonard Electric Co, Mt Vernon, N. Y.

B31 **SWITCHGEAR** — Custom-tailored, low- and medium-voltage *Esco* equipment. 8-page bulletin 521 gives basic specifications, describes engineering service available. Electric Service Engineering Co, 10 Third Ave, Joliet, Ill.

B32 **ELECTRICAL FITTINGS** — Solderless wire connectors, cable and conduit fittings, wiring devices. 12-page catalog 52 has diagrams, photos, dimensions. Buchanan Electrical Products Corp, Hillside, N. J.

B33 **ELECTRICAL CONTACTS**—Made of silver, palladium, nickel, silver alloys, and powdered metal compositions. 12-page booklet C-520 has chart showing best contacts for various applications, photos, dimensions. Gibson Electric Co, 8389 Frankstown Ave, Pittsburgh 21, Pa.

B34 **SOLDERLESS WIRE TERMINATIONS**—Quality control of entire manufacturing process, from raw metal through manufacture, to finished installation. 12-page bulletin with photos. Aircraft-Marine Products, Inc, 2100 Paxton St, Harrisburg, Pa.

B35 **INSULATING TAPE** — Plastic, self-bonding type for wire and cable splicing. 4-page bulletin B-100 shows application, properties of *Bi-Seal* tape. Bishop Mfg Corp, 132 Factory St, Cedar Grove, N. J.

B36 **LIGHTNING PROTECTION** — Arrester and terminal facilities and accessories for low-voltage circuits. 16-page catalog 48-A describes arresters, fuses, terminals, rare gas relays, etc. Photos, dimensions, price sheet. Brach Mfg Corp, 200 Central Ave, Newark 4, N. J.

HEAT EXCHANGERS

B37 **DEAERATING HEATERS** — Tray and spray-tray types. 12-page bulletin WC-106 describes principles, elements, features, gives applications, photos. Graver Water Conditioning Co, Dept 10-6, 216 W 14th St, New York 11, N. Y.

MAINTENANCE MATERIALS

B38 **SHEET PACKING** — *Caroil* bonded cork for general service, auto, diesel, storage tank, etc, gaskets. Standard and HP grades in sheets or gaskets. 4-page bulletin gives properties, service recommendations. James Walker Packing Co, Inc, 96 Liberty St, New York 6, N. Y.

B39 **FLOOR MAINTENANCE** — For asphalt, cork, concrete, linoleum, composition, etc, floors. 12-page bulletin gives conditioning, polishing, maintenance suggestions for each type of floor. A C Horn Co, Inc, Tenth St and 44th Ave, Long Island City 1, N. Y.

B40 **LUBRICATION** — June issue of *Lubrication* magazine devoted to "Electric Power—Steam Turbine Lubrication." 16 pages. Drawings, diagrams. The Texas Co, 135 E 42nd St, New York 17, N. Y.

B41 **SOLUBLE OILS**—And other cutting and grinding fluids. 8-page bulletin suggests uses, applications. Chart recommends proper oil and dilution for boring, broaching, tapping, etc, on steel, aluminum, bronze, copper. Aldrige Industrial Oils, Inc, 3401 W 140th St, Cleveland 11, Ohio.

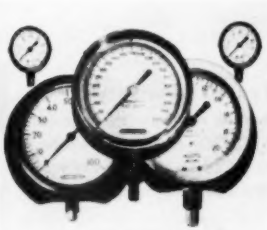
B42 **DUST COLLECTOR** — Self-contained, bag-type unit for sawing,

The NAME to REMEMBER:

Lonergan

for EVERYTHING in

GAUGES



—28 TYPES—
—OVER 100 MODELS—
—16 CASE STYLES—

Lonergan Pressure Gauges are preferred widely in power and process industries for their accuracy, dependability, exact engineering and modern design. They are made in sizes from 2½ to 12 inches and utilize Bourdon tube, diaphragm or bellows power elements in conjunction with modern precision movements.

Lonergan representatives in all industrial centers are ready to advise you competently on your gauge needs. *Call on them or write us for catalog 800-G.*

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LONERGAN SAFETY-RELIEF VALVES
for every purpose

A large variety of standard types for all needs. Nearby distributors can supply you.

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Race and Second Sts., Phila. 6, Pa.
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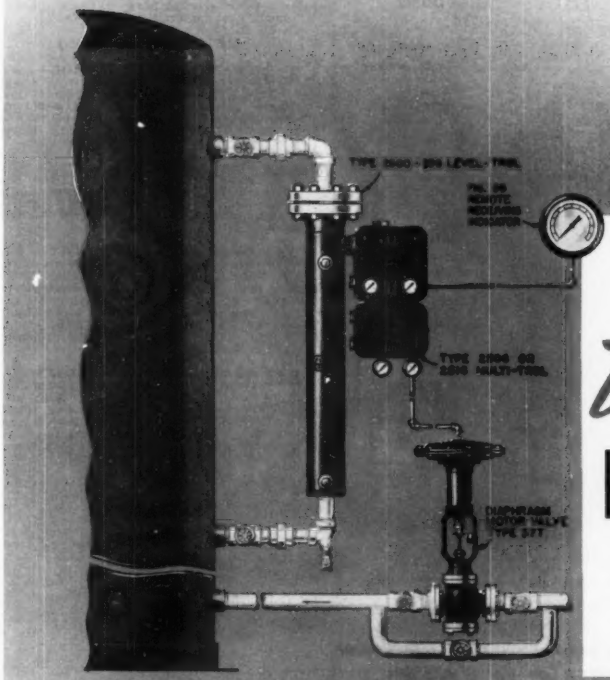


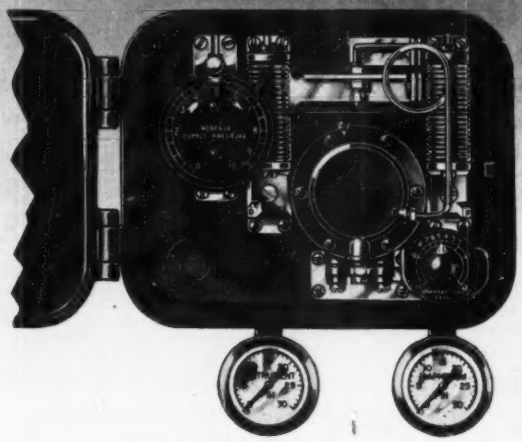
New!

FISHER®

Dual Control

LEVEL-TROL

This new Fisher Controller consists of a primary pilot (standard Fisher Series 2500 Level-Trol — used for indicating or controlling level) whose output is transmitted by pneumatic link to secondary pilot — the Multi-Trol.



MULTI-TROL FEATURES

1 — Available with reset (Type 2516) or without reset (Type 2506). (Reset may be added to units originally furnished without it.)

2 — Proportional band adjustment is incorporated into the remote receiver controller with a range of 10% to 200%.

3 — Level control point is adjustable manually in the case by level set adjustment. For remote set — provided with connection for remote air loading.

4 — Pressure balanced type of relay provides intermittent bleed and gives accurate stable control.

5 — Pilot may be changed from a direct acting to a reverse acting unit or vice-versa, thru the use of switch plates.

6 — Pilot may also be changed from proportional action to two position action or vice-versa, by repositioning a switch plate.

Complete information will gladly be sent upon request.

FISHER GOVERNOR COMPANY, MARSHALLTOWN, IOWA

FISHER® LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

INDUSTRIAL

PYROMETER & SUPPLY CO. • • •

WORLD'S LARGEST MFR. PYROMETER & THERMOCOUPLE EXTENSION LEAD WIRE

INVITES pyrometer Engineers, Maintenance men, Buyers, Plant Executives to visit our booth #411-413 and receive an invitation for an enjoyable evening.

- THERMO-COUPLES,
- PYROMETER TUBES,
- WIRES,
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and

- INSULATORS for ALL MAKES of PYROMETERS

You and your associates (bring the ladies) are cordially invited to visit us in the Grand Ballroom, Hotel Carter, Cleveland, from 9 p.m. 'til ? Monday, Tuesday, and Thursday September 8th, 9th, and 11th, 1952

Refreshments • Bar • Dancing • Entertainment

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Avery Hack • Frank Hack • A. J. McBride

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Alton, Illinois, U.S.A.

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Please present this invitation at entrance.

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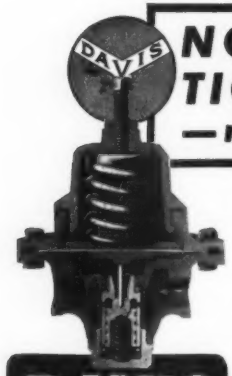
We operate our own wire insulating mills



NON-STICKING! TIGHT CLOSING! —no pressure build-up

EXCLUSIVE DESIGN—

Single seated, tight closing, non-sticking. Large diaphragm, sensitive pressure adjustment. Compact, rugged, self-contained.

TROUBLE-FREE SERVICE—

Built-in strainer, finest quality, all internal parts readily accessible and renewable without disturbing piping. Long economical service with minimum time out for repairs or replacement.

FOR STEAM, AIR OR GAS—

For initial pressures to 250 p.s.i.; reduced pressures, 1 to 100 p.s.i. Sizes from $\frac{3}{8}$" to 2". Semi-steel bodies bronze or stainless trim. Economical for use on small units. *Write for Bulletin 100-A.*

DAVIS NO. 13 AUTOMATIC PRESSURE REDUCING VALVES

DAVIS REGULATOR CO.
Established 1875
2520 SO. WASHTENAW AVE. CHICAGO 8, ILL.

More FREE BULLETINS

Begins on page 163

planing, jointing, milling, routing operations. 4-page bulletin 635 gives *Dustbuster* specifications, ratings. Photos. Aget-Detroit Co, Ann Arbor, Mich.

MATERIALS HANDLING

B43 **CRANE HOIST CONTROL**—*Load-o-matic* unit for ac service. 8-page bulletin B-5417 explains operation, shows construction, mounting, performance characteristics. Motor speed-torque curves. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

B44 **WINCHES** — *Low-Mount* units with ratings of 15,000 and 20,000 lbs. 2-page bulletin 149T gives features, dimensions, drawings. Gar Wood Industries, Customer Service Dept, Wayne, Mich.

B45 **CASTERS AND TRUCKS** — For light, medium or heavy loads on all floor surfaces. 36-page catalog CT-52 describes swivel and rigid casters in steel-forged, cold-forged, stamped construction, metal, plastic and and rubber wheels. Rapids-Standard Co, Inc, Dept CT-52, 342 Rapistan Bldg, Grand Rapids 2, Mich.

B46 **SMALL PARTS HANDLING** — Hardwood box control system employs master hardwood unit with adjustable dowel separators or peg trays for keeping small parts separated and in order. 4-page bulletin A-40 gives features, drawings. Albert Wesling & Sons, Inc, 2912 W Lake St, Chicago 12, Ill.

B47 **MILLING AND PROCESSING EQUIPMENT** — Screw and belt conveyors, bucket elevators, bulk-flow and oscillating conveyors, dryers, vibrating screens, drives, bearings, etc. 16-page bulletin 2392 gives photos, uses. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

METALS AND ALLOYS

B48 **ALUMINUM, STEEL, BRASS AND COPPER ALLOYS**—Forms, uses, weights and measures, tempering, cleaning, gage comparison, tables on conversion, tolerances, conductivity, melting points, etc. 120-page catalog and handbook has separate sections on each metal. Eastern Brass & Copper Co, Inc, 1122 E 180th St, New York 60, N. Y.

B49 **ALUMINUM ALLOYS** — Composition, properties, heat treatments, applications. Cross-reference to ASTM, SAE and Alcoa designation of similar alloys. 14-page folder gives information in chart form. Apex Smelting Co, 2537 W Taylor St, Chicago, Ill.

B50 **GRAIN SIZE** — 4-page folder stresses relation of grain size to physical characteristics of brass. Shows how annealing and cold-rolling affect grain size. Photos, charts. Bridgeport Brass Co, Sales Promotion Service, Bridgeport 2, Conn.

B51 **STEEL CASTING SPECIFICATIONS** — One-page wall chart lists more than 70 designated classes of castings, gives heat treatment, chemical compositions, mechanical properties. Mr. F Kermit Donaldson, Steel Founders' Society of America, 920 Midland Bldg, Cleveland 15, Ohio.

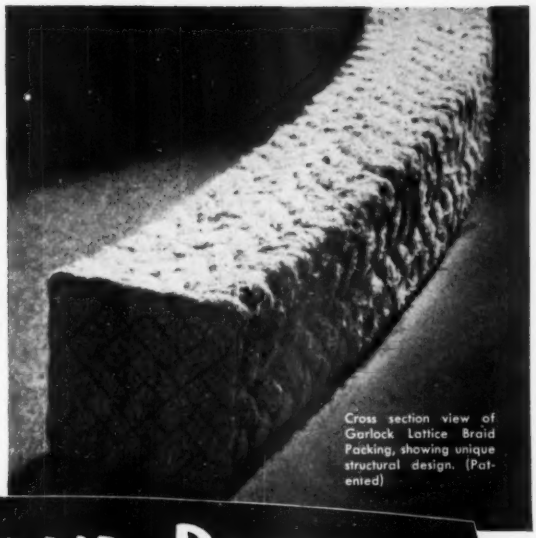
B52 **GRAPHITIZATION RESEARCH** —Nature and effects of graphitization, preventive and corrective measures. 12-page booklet has photomicrographs, charts. Edward Valves, Inc, Dept GA, East Chicago, Ind.

METERS AND INSTRUMENTS

B53 **THERMOCOUPLES** — Assemblies and parts. 44-page catalog EN-82 gives accuracy, temperature, and physical limits, recommends protecting tube and well materials. Photos, specifications. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

B54 **THERMOCOUPLES** — Also radiation detectors, resistance bulbs, other accessories for indicating, controlling and recording instruments. 40-page catalog TC-9 gives prices, applications, selection data. Drawings,

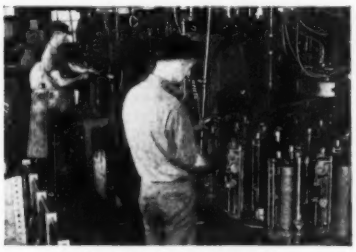
For Long Trouble-Free Service USE



Cross section view of Garlock Lattice Braid Packing, showing unique structural design. (Patented)

LATTICE-BRAID PACKING

GARLOCK 751 (cotton) Lattice-Braid Packing for hot or cold water.



GARLOCK'S specially designed Lattice-Braiding machines.

The Greatest Improvement Ever Made in Braided Packings!

The strands of Garlock Lattice-Braid packings are braided *through* and *through* on specially designed braiding machines. Since all strands are strongly linked together into a single unit, they are firmly held together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

This exclusive lattice braiding also provides unusual flexibility and semi-automatic pressure action which keeps the packing properly adjusted in the stuffing box. Longer service with less attention.

Garlock Lattice-Braid is manufactured from flax, cotton, asbestos, wire-inserted asbestos and "Teflon"—for various types of service. Furnished in ring, coil or on reels.

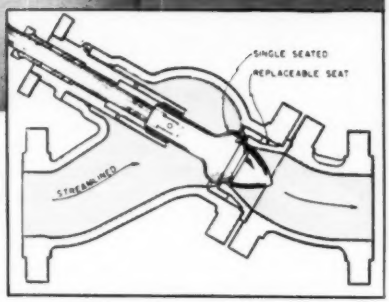
Write today for the new Lattice-Braid Folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS,
MECHANICAL SEALS,
RUBBER EXPANSION JOINTS



The *New CONO-ESS* valve, with its streamlined body contours and single-seated construction, marks a big advance in reducing-valve body design and obsoletes the conventional double-ported, globe pattern control valves. CONO-ESS valve may be actuated by either the revolutionary air-powered gear-drive ROTOMOTOR or the unique air-powered CONO-CYLINDER. You get years of trouble-free service without the headaches usually associated with conventional steam reducing valves.

Available in sizes 1½" to 8", for pressures up to 1500 psi at 1000° F. Rotomotor-operated valves have declutching handwheel for manual operation in case of power failure, eliminating need for expensive bypass. Single-seated construction assures drop tight shut-off when closed.

BULLETIN C-1 gives information on various applications and details of operation. Write for it today.

CONOFLOW CORPORATION
2100 ARCH ST., PHILADELPHIA 3, PA.

Cono-Controls

CC-118

More FREE BULLETINS

Begins on page 163

charts. Wheelco Instruments Div, Barber-Colman Co, Rockford, Ill.

B55 **SOCKET METER MOUNTINGS**—6-page folder 53 pictures representative stock items, gives prices. Code Electric Products Corp, 214 Kalos St, Philadelphia 28, Pa.

B56 **PRESSURE GAGES** — Indicating and recording types, accuracy within ± 1% of total span. 4-page specification sheet 708 gives specifications, photos, dimensions. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

B57 **MANOMETERS**—12-page manual, bulletin 313, gives basic facts and definitions for pressure measurement, explains manometer operation, installation, maintenance. Diagrams, charts. King Engineering Corp, Box 510, Ann Arbor, Mich.

B58 **FLOW METERS** — Variable-area units with tapered metering tubes. 12-page catalog 40 discusses armored *Flowrator* units for high-temperature, high-pressure and hazardous service, shows meter extensions. Photos, specifications. Fischer & Porter Co, 6390 County Line Rd, Hatboro, Pa.

B59 **RESISTANCE THERMOMETERS** —For temperature measurements in steam generating stations. 4-page data sheet 9.1-12 gives details on dc Wheatstone bridge circuit, thermometer bulb design, continuous balance recorders. Minneapolis-Honeywell Regulator Co, Brown Instruments Div, Station 40, Wayne & Windrim Aves, Philadelphia 44, Pa.

PIPING, VALVES, FITTINGS AND SPECIALTIES

B60 **PIPE PROPERTIES** — Dimensions, areas and weights, pressure/stress moduli. 10-page reprint from Tube Turns' catalog and data book No. 211 tabulates properties of commercially-available steel pipe, lists seamless welding fittings. Tube Turns, Inc, Louisville 1, Ky.

B61 **MECHANICAL TUBING** — Cold-drawn, seamless carbon steel tubing. 4-page bulletin TB-339 gives tolerances, mechanical properties, suggests production advantages in making machined parts from tubing. Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

B62 **HEATING SPECIALTIES** — For hot water systems. Circulator, flow valves fittings, air reducers, relief and regulating valves, accessories. 8-page bulletin H-355 gives photos, piping layouts. Trane Co, La Crosse, Wis.

B63 **SAFETY RELIEF VALVE**—For hot water boilers, tanks and heaters, ASME approved. 4-page bulletin 290 gives photos, dimensions, price. A W Cash Valve Mfg Corp, 666 E Wabash Ave, Decatur 60, Ill.

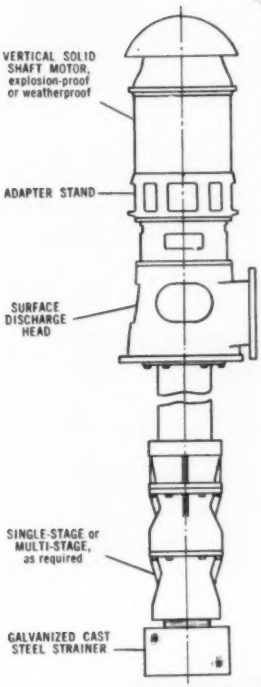
B64 **ALTITUDE CONTROL VALVE**—*Cushioned* units maintain water levels within 3 to 12 in. variation. Standard, differential, stop-check, combination, electric, etc, types. 16-page bulletin W-4 gives operation, dimensions, parts list, installation arrangements. Golden Anderson Valve Specialty Co, 2070 Keenan Bldg, Pittsburgh 22, Pa.

B65 **PACKLESS EXPANSION JOINTS** *Corrugflex* type, single and double self-equalizing and non-equalizing joints. In sizes 3 to 54 in. 28-page bulletin 35-51A gives selection, specifications, installations, shows variations from basic joint. American District Steam Co, Inc, N Tonawanda, N. Y.

WELDING

B66 **MAINTENANCE WELDING**—For coal mines. 16-page booklet discusses specialized operations like heavy cast iron repairs, dragline shovel pinion repair, pump and compressor repairs, etc., based on actual work. Eutectic Welding Alloy Corp, Dept P, 172nd St and Northern Blvd, Flushing 58, New York, N. Y.

NOTES FROM THE PUMP ENGINEER'S HANDBOOK

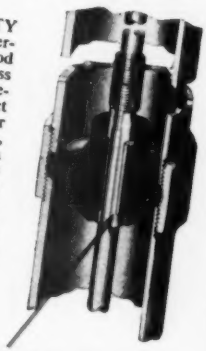

VERTICAL SOLID SHAFT MOTOR, explosion-proof or weatherproof
ADAPTER STAND
SURFACE DISCHARGE HEAD
SINGLE-STAGE or MULTI-STAGE, as required
GALVANIZED CAST STEEL STRAINER

VERTICAL TURBINE COOLING TOWER PUMPS

The vertical turbine cooling tower pump has many advantages over other types. No suction valves or suction piping are required. With the pump bowls immersed in the tower sump, the operator is assured that the pumps are always primed; thus, are ideal for remote control or automatic operation. Vertical turbine pump horsepower requirements decrease as capacity increases, a characteristic which enables this type of pump to operate more efficiently at wider range of throttled capacity.

SHAFT WEAR CAN'T HAPPEN to a Johnston Water-Lubricated Pump!

Here's another QUALITY feature that makes Johnston Water-Lubricated Turbine Pumps a good investment. The renewable stainless steel sleeves which shroud the line-shaft at all points of bearing contact make it impossible for sand or other abrasives to damage the shaft. Sure, the sleeve and bearings wear on a Johnston just like they do on any pump . . . but think of the savings on parts and labor alone when you simply replace a sleeve instead of a complete section of shafting. What's more, you don't need a lot of special tools to do the job! Do it at the pump site . . . just unscrew the old sleeve and thread on the new!!!



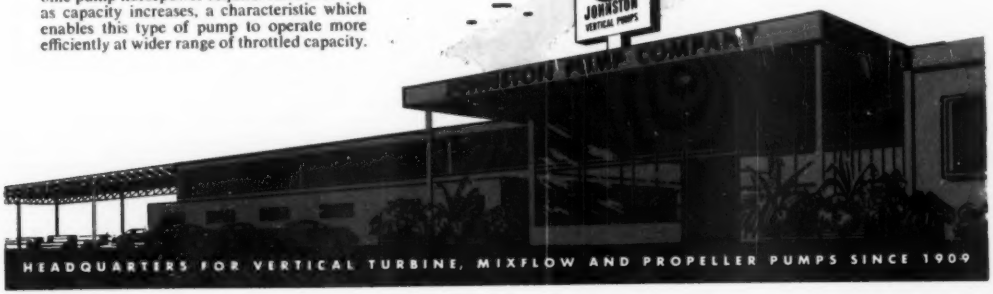
LITTLE DETAILS LIKE THE RENEWABLE SHAFT SLEEVE MAKE JOHNSTON PUMPS BETTER!!!

Trained hydraulic engineers are available at your nearest Johnston Dealer or at the Johnston factory to furnish detailed information, proposals and anything else necessary to meet your particular pumping equipment needs.

THERE'S A JOHNSTON PUMP FOR EVERY PURPOSE

Sizes range from 4 to 32 inches; single- or multi-stage; 2 to 1000 H.P.; capacities to 10,000 G.P.M.; lifts to 1000 feet; for liquid temperatures to 400° F.

JOHNSTON PUMP COMPANY
3272 EAST FOOTHILL BLVD., PASADENA 8, CALIFORNIA



HEADQUARTERS FOR VERTICAL TURBINE, MIXFLOW AND PROPELLER PUMPS SINCE 1909

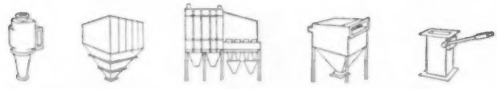
Your Management wants to know...

HOW FLY ASH PROBLEMS CAN BE SOLVED ECONOMICALLY!

PLANT ENGINEERS, working with Buell engineers, have proven again and again that their know-how coupled with Buell's long experience in Dust Collection can solve your Fly Ash problems more economically, more efficiently.

What's more, Buell Dust Collection Systems offer all American industry these further advantages: smoother plant-community relations, improved product quality and higher employee morale.

Buell's knowledge and experience in the highly specialized science of Dust Collection are yours. To learn more about Buell's **3 basic systems** of Dust Collection and how they can help you, send for the new, informative booklet titled, "The Collection and Recovery of Industrial Dusts." Buell Engineering Company, Dept. 50-H, 70 Pine Street, New York 5, New York.



Van Tongeren Cyclone | 'SF' Electric Precipitator | Precipitator Cyclone Combination | Type 'LR' Collector | Dust Hopper Valves

ELECTRIC CYCLONIC ® buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

APPOINTMENTS

New Corporation Executives

Edward O Boshell, president of Westinghouse Air Brake Co, is elected a director of **Westinghouse Electric Corp.** John Anderson, assistant secretary of **General Electric Co** retired recently after almost 42 years of service.

George C Wilder takes over as president and a member of the board of directors of the **Macwhyte Co.** Thomas W Simmons Jr is new president and general manager of **Johnston Pump Co.**

New vice-president in charge of sales for the **Fairbanks Co** is Edmund T Flanagan. A E Harrant is now executive vice-president and A C Mulder vice-president in charge of production at **Miller Electric Mfg Co.**

John W Lohnes is new vice-president of sales for the Jeffers Electronics and Speer Resistor Divisions of **Speer Carbon Co.**

Cummins Diesel Sales Corp advances W B Lawrence to vice-president; he will continue as general manager of the corporation's dealerships. Wm H Franklin is elected vice-president and secretary at **Caterpillar Tractor Co,** and A N Whitlock becomes the new controller.

Russell T Branch

Stevens Institute of Technology confers an honorary degree of Doctor of Engineering on Russell T Branch, president of **Stone & Webster Engineering Corp,** on the 40th anniversary of his graduation from the institution. He is cited as a "master constructor, noted engineer, and eminent executive."

T Hunt Vaden becomes vice-president of the **Alabama Power Co.** New vice-president in charge of manufacturing at **P R Mallory & Co** is Frank B Powers. **Thermoid Co** elects Lester F Cox executive vice-president and executive manager.

Shawinigan Water and Power Co names N P Woods vice-president, finance, and treasurer. Leo E Boissonnault is his assistant. H G Horstman becomes assistant to the president of **Texas Gas Transmission Corp.**

New Operations Executives

Worthington Corp names three new managers of centrifugal pump sections: Roy Carter, volute pump section; L H Garnar, process pump section; I J Karassik, multistage pump section.

H Ward Hathaway retires as manager of the federal and marine dept of **Warren Steam Pump Co, Inc.** He had joined the

No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY · PITTSBURGH, PA.

MARTINDALE PROTECTIVE MASKS

PLACE HEAD-BAND WELL UP AROUND HEAD TO KEEP FROM SLIPPING DOWN
PRESS NOSE TABS IN CLOSE AGAINST FACE TO HOLD PAD AGAINST THE NOSTRILS
PRESS EDGES OF FACE PLATE DOWN TO FIT FACE SNUGLY

Weigh Less than ½ ounce.

Clean, cool, comfortable. Furnish excellent protection against non-toxic dusts except free silica. Replaceable cotton pads are inexpensive and sanitary.

Martindale Protective Masks	$.30 ea.
No. 1 Refills (Standard weight)	.02 ea.
No. 2 Refills (heavyweight)	.02½ ea.

Masks packed in individual envelopes. Refills packed in envelopes containing 25. No. 2 (heavyweight) Refills contain twice as much filtering cotton as No. 1.

DISCOUNTS

Less than $10.00 list	Net
$10.00 to $24.99 list	10%
$25.00 to $99.99 list	15%
$100.00 and over	20%
Minimum, charge account or C.O.D.	$2.00
Minimum, cash with order	$1.00

If payment accompanies order we will pay parcel post or express charges.

MARTINDALE ELECTRIC CO.
1367 Hird Ave. Cleveland 7, Ohio

More APPOINTMENTS

Begins on page 226

company in 1904, and was also a member of the National Recovery Administration advisory board for the steam pump industry. Howard L Glass succeeds him as department manager.

Howard A Blair becomes product manager of self-contained products, air conditioning div, **Westinghouse Electric Corp,** and Joseph S Parry Jr, is assistant manager of the apparatus div. At **Norton Co,** Loring F Coes Jr is appointed assistant director of research and development in charge of the laboratory's organic section. George E Prifold now heads the LVT div, Ingersoll Products Div, **Borg-Warner Corp.**

Walter J Becker, assistant to the president and manager of the technical service division of **International General Electric Co,** has retired after 41 years of service. David B Lawton is named manager of GE's newly-planned transformer manufacturing plant at Rome, Ga., and Carl F Olson is sales development supervisor for insulating materials at the alkyd resin products plant.

New general manager of the Huntington Works of **International Nickel Co, Inc,** is E M Kline. He succeeds Herman M Brown, who has retired, but will continue as a consultant for the company. C K Crosby becomes assistant general manager.

J M Johns assumes new duties as general manager of the new fiber glass division of **Libbey-Owens-Ford Glass Co.** G T Kaufman is manager, engineering service, of the Petro heating and power equipment division of **Iron Fireman Mfg Co.** New production manager of both Newark plants of **Tenney Engineering, Inc,** is J V Kielb.

Harold H Hall is now general manager, Cummins Diesel Export Corp, and Charles C Sons is named acting general service manager for **Cummins Engine Co.** Product manager of the caster and truck division of **Rapids-Standard Co, Inc,** is Kenneth P Denisty.

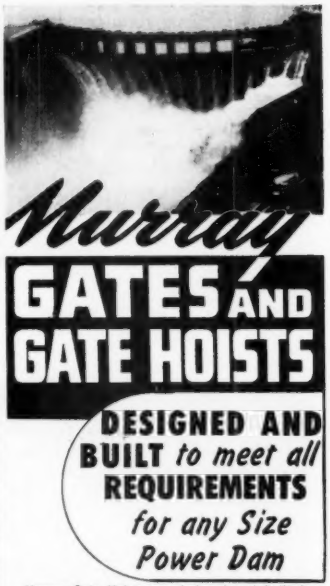
Gerald V Williamson becomes superintendent of the power production division, **Union Electric Co of Missouri.** Albert W Howell is superintendent of hydro and system operators under Williamson. **National Supply Co** appoints Stover E Harger plant controller at Toledo, succeeding Loren R Michael, who has retired. Ted C Gorman is purchasing agent for the **Heli-Coil Corp.**

Sales Appointments

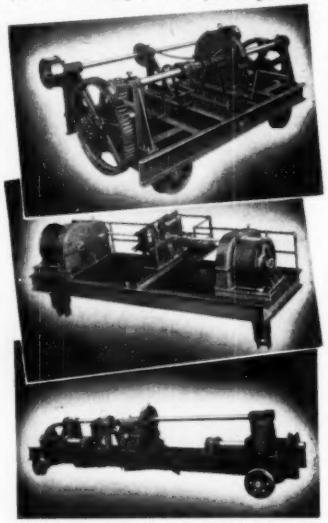
Link-Belt Co appoints James H Oakes sales manager for the Philadelphia plant, and Byron K Hartman sales manager for the new Colmar plant. George A Most Jr becomes district manager at Moline, Ill, succeeding Stuart T Penick who becomes sales engineer specializing in power plant coal-handling equipment at Colmar.

Three new branch office industrial managers are named by **Minneapolis-Honeywell Regulator Co:** Robert W Woodside, Cleveland; John O Paull, Los Angeles; Lee Alpin, San Francisco.

Truman B Brown is appointed assistant to the vice-president, sales, of **Allegheny**



Murray Gate Hoists are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist.



During our over half century of designing and building gate hoists, we have developed many designs for the different types of gate hoist problems. Perhaps we have several designs and patterns that will fit your requirements. In planning gates or gate hoists, we suggest you communicate with us before your plans for the project as a whole, are complete . . . it will save expense and much preparation time. We also build gate hoists especially from your plans and specifications, if desired.

Write for complete information and Engineering Department recommendations.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU · WISCONSIN
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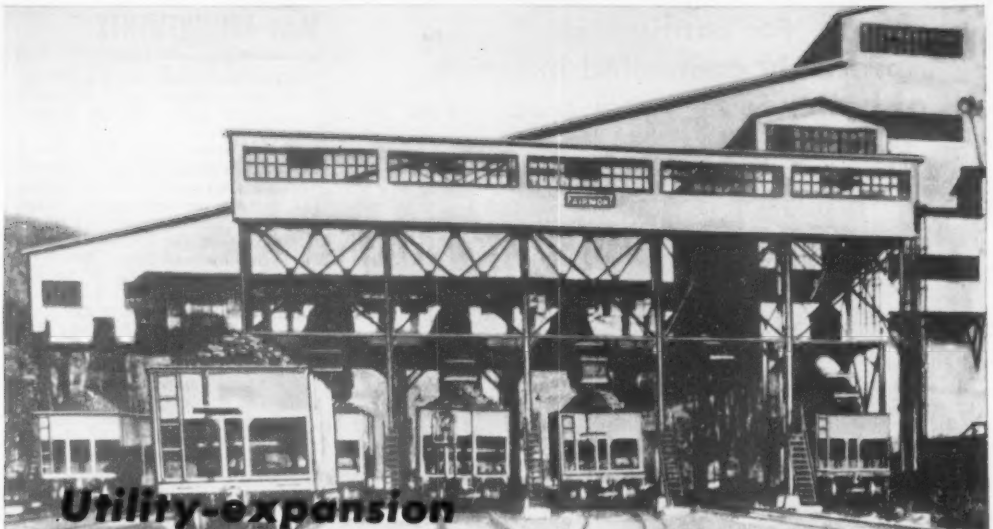


Utility-expansion

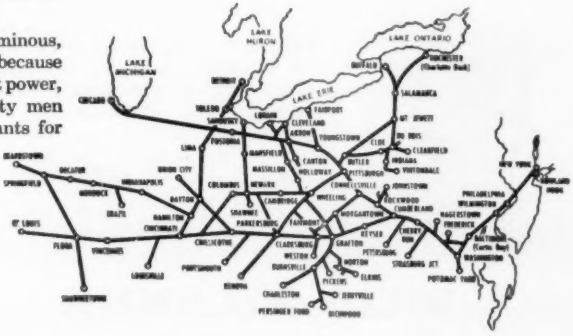
GO AHEAD

is written in fields of Bituminous!

● *Production for Freedom* has placed a tremendous burden on the shoulders of the electric power industry—which, since World War II, has spent more for expansion than any other. Bituminous coal has played an important role. In 1951, utilities consumed approximately 102,000,000 tons, the highest of record, or about 20% of the National production. By the end of 1954, the electric industry will have increased generating capacity to 104 million kilowatts—from the 75 million at the end of 1951!

Thanks to vast *known* deposits of Bituminous, such expansion can be taken in stride. And because Bituminous is an efficient source of low-cost power, in a supply sufficient for centuries, utility men will be wise to continue to plan new plants for this dynamic fuel.

In Baltimore & Ohio territory is a large proportion of operating Bituminous mines. New mines—highly mechanized for economical operation—are opening constantly. The coals produced are excellent in quality, wide in variety, and convenient to industrial areas. We'll be glad to advise you—just *ask our man!*

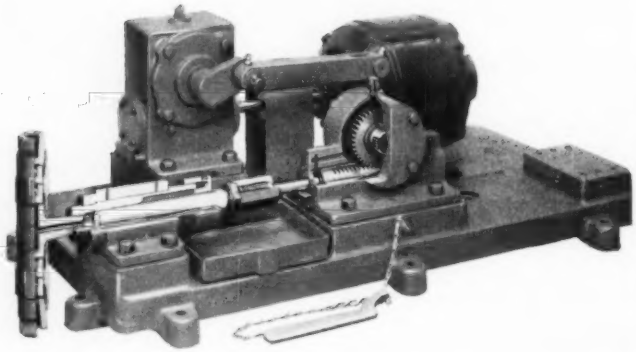


BITUMINOUS COALS
FOR EVERY PURPOSE

BALTIMORE & OHIO RAILROAD

Constantly *doing things* **—better!**

For continuous, precisely controlled injection of boiler feed water treatment



. . . the HILLS-McCANNA "U" Type Proportioning Pump

The Hills-McCanna "U" Type Pump is designed to continuously meter and proportion small flows of the order of 0.10 to 24 gallons per hour per feed. Its accuracy and reliability ideally suit it for power plant applications such as the continuous injection of internal phosphate treatment and sodium sulphite oxygen scavenging in feed water treatment. Design of the pump is such that it may also be used for batch operations where this is preferred.

The "U" Pump is ruggedly and simply designed for long, dependable service and is furnished as a "packaged" unit, complete with motor, drive and pump mounted on a common base. Available with one to four feeds.

The new "U" Pump Catalog, UP-52, gives full information on the "U" type pump plus extensive application data including specific service recommendations for handling over 300 substances. Write for your copy, today. HILLS-McCANNA CO., 2369 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of: Saunders Patent Diaphragm Valves Force Feed Lubricators • Magnesium Alloy Sand Castings

More APPOINTMENTS

Begins on page 226

Ludlum Steel Corp; Ian R Kiltie succeeds him as Detroit district manager of sales; H H Lardin becomes assistant manager.

Westinghouse Electric Corp expands its Sturtevant division air handling department. Eight new regions, their headquarters and managers are: northeastern, Boston, J H Spencer; middle Atlantic, Philadelphia, H F Brush; north-central, Cleveland, Robert Mercer; northwestern, Chicago, D W Davis, Jr; southwestern, St. Louis, W J Oonk; southeastern, Atlanta, D M Hutchinson; south-central, Pittsburgh, H W Rainey Jr; eastern, New York, John F Munder. New sales manager of Westinghouse industrial products is F D Weatherholt, and new eastern district manager of the marine dept is James C Frink.

Ladish Co appoints Richard M Bode to an executive sales position in its valve and fittings division. **American District Steam Co, Inc,** opens a new branch in Cleveland and appoints Wm J Daugherty district manager. At **National Electric Products Corp,** John L Marsh becomes midwest regional specialist on all products, with headquarters in Chicago.

Graver Water Conditioning Co appoints Harold R Fosnot assistant general sales manager, and Leonard Limon manager, sales engineering department. Sales and management changes at **Dowell Inc,** are as follows: R D Shaw becomes director of sales; Marshall Stirling moves to Tulsa as general sales manager, W N Estel is promoted to assistant general manager of the company.

Johnson Service Co appoints Trevor D Reiley manager of the Cincinnati branch; Norman A Ballinger manager of the Louisville office; Wm P West now directs the Georgia, Florida, Alabama and Tennessee offices.

Obituaries

Henry J Fortier, 62, vice-president in charge of sales and member of the board of directors of Foster Engineering Co, died June 14. He had been with the company for 37 years, was a member of Industrial Marketing Associates, Inc, and the Instrument Society of America.

Jessel S Whyte, 61, president and general manager of the Macwhyte Co, died May 28 at Kenosha, Wis.

Cecil C Willis, 53, superintendent of generation for Oklahoma Gas and Electric Co, died at Oklahoma City June 27. He had been with the company for 30 years.

Robert F Burke, 67, president of the Boiler Engineering and Supply Co, died June 25 in Phoenixville, Pa.

Arthur M Long, 63, assistant general manager of sales for the Youngstown Sheet and Tube Co, died suddenly at Evanston, Ill, late in May.

John Alwyn MacMillan, director and former president and chairman of the board of the Dayton Rubber Co, died June 7. He was 79.

Joseph W Mullally, 54, manager of utility sales for Anaconda Wire & Cable Co of New York, died on June 10 in Washington, D. C.

BATTLESHIP CONSTRUCTION
Built above and beyond the demands of average service. Photo shows fan with section of housing removed.

These HEAVY-DUTY FANS Now Operating in 43 States and 15 Foreign Countries

Wide popularity — and deserved! Clarage Type RT Fans bring efficient performance and tremendous endurance to your **most exacting** jobs — induced draft, forced draft, and furnishing air for industrial processes . . . pressures to 38.6 inches (standard air); temperatures to 1000 deg. F.; capacities to 300,000 c. f. m.

Here is **HEAVY-DUTY fan equipment** which carries the endorsement of consulting engineers, plant engineers and boiler manufacturers. Install RT Fans and your first cost is the last — for a **long time** to come. Call us in for specific recommendations!

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Applications, specifications and available arrangements all covered in catalog. Send for your copy today.

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SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

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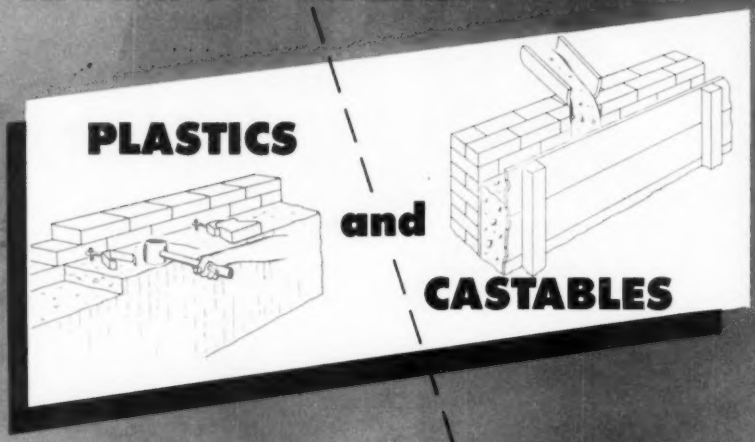
HARBISON-WALKER



Top Quality Boiler Furnace Refractories

- For complete MONOLITHIC LININGS
- For quick, economical emergency REPAIRS
- For SPECIAL SHAPES

For walls, arches, baffles, and difficult irregular contours, as well as for repairs and patching, Harbison-Walker Plastic and Castable refractories have proved to be effective, economical and durable.

H-W PLASTIC FIRE BRICK are available in Standard and Super Duty grades of excellent workability. Shipped in cartons, ready for use. Readily rammed to any shape or contour; special experience not necessary.

H-W CASTABLES are shipped in dry form, to be mixed with water and poured or tamped into place. Made in various classes suitable for each particular requirement for high operating temperatures, maximum strength and abrasion resistance, and in light weight for efficient insulation.

These Harbison-Walker products have been developed and perfected through research and experience in use. They embody the desirable characteristics needed for power plant applications.

Write for illustrated descriptive bulletin.

HARBISON-WALKER REFRACTORIES CO.
AND SUBSIDIARIES
World's Largest Producer of Refractories
GENERAL OFFICES PITTSBURGH 22, PENNSYLVANIA

NO GETTING AROUND IT

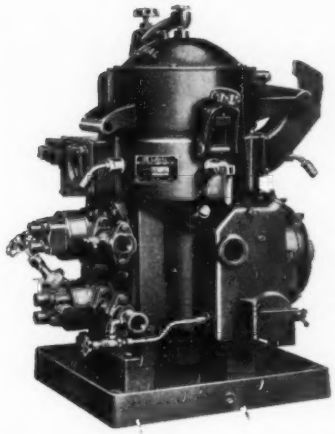
CENTRIFUGING DIRTY OIL PAYS BIG DIVIDENDS

A De Laval Oil Purifier makes every machine tool in the plant a better producer. Using centrifugal force to remove solid impurities ***and*** water from all types of factory oils, De Laval Oil Purifiers restore used oils to "like-new" clarity and cleanliness. They do this continuously and virtually instantaneously.

But the dividends don't stop there! Production advantages are often as important as the savings in oil. Take the advantages of purifying cutting oil, for instance—

1) Tools cut better because the metallic particles that ruin cutting edges have been removed.
2) The machine tools last longer because harmful grit and dirt and chips are absent.
3) Work output rises because uniform quality of cutting oil helps to maintain uniformity in cutting work.

De Laval Oil Purifiers "pay dividends" in small as well as in large plants. Write for Bulletin MM-1 for a checklist of possible applications.



THE DE LAVAL SEPARATOR COMPANY
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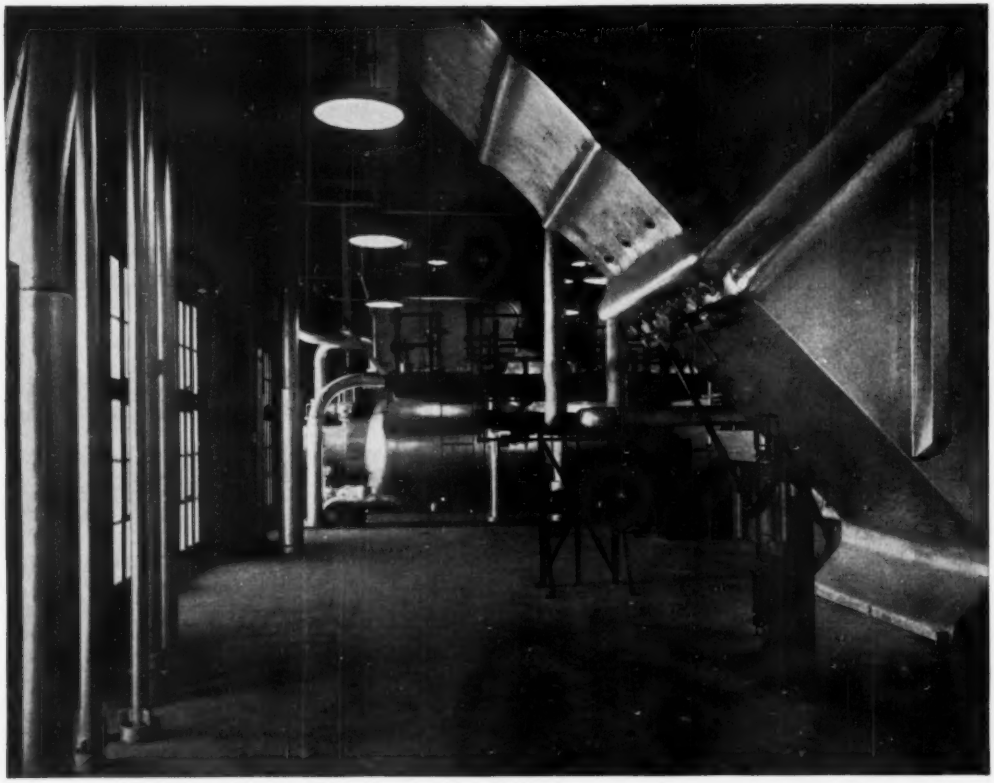
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION



How these K&M insulations keep heat under power's "thumb"

THE PICTURE ABOVE, taken in a large Eastern power station, is good, but it can show only the "skin-deep" beauty of the Keasbey & Mattison Insulations on the feed water deaerator in the background and the duct in the right foreground. Under the glistening surfaces, finished tightly with K&M Insulating Cement, lies this interesting heat-keeping story.

On the feed water deaerator, the "defense in depth" against heat loss is provided by K&M Hy-Temp Blocks, 1½" thick, covered with "Featherweight" 85% Magnesia Blocks, 1½" thick...an ideal combination that makes the most of the high heat-resisting qualities of Hy-Temp and the high insulation value of "Featherweight" 85% Magnesia. Alone, "Featherweight" 85% Magnesia is good for temperatures up to 600° F. (on the duct shown it is more than sufficient); its combination with Hy-Temp provides efficient insulation from 600° to 1900° F.

These K&M Insulations are practical, economical, and durable. The insulating properties of "Featherweight" 85% Magnesia are not affected by alternate heating and cooling . . . by wetting and drying . . . and, being mineral in nature, will not burn. Both insulations are supplied in appropriate forms and thicknesses for all equipment surfaces and piping.

Your K&M distributor, who is an experienced applicator, will give you full information. Or write us direct.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

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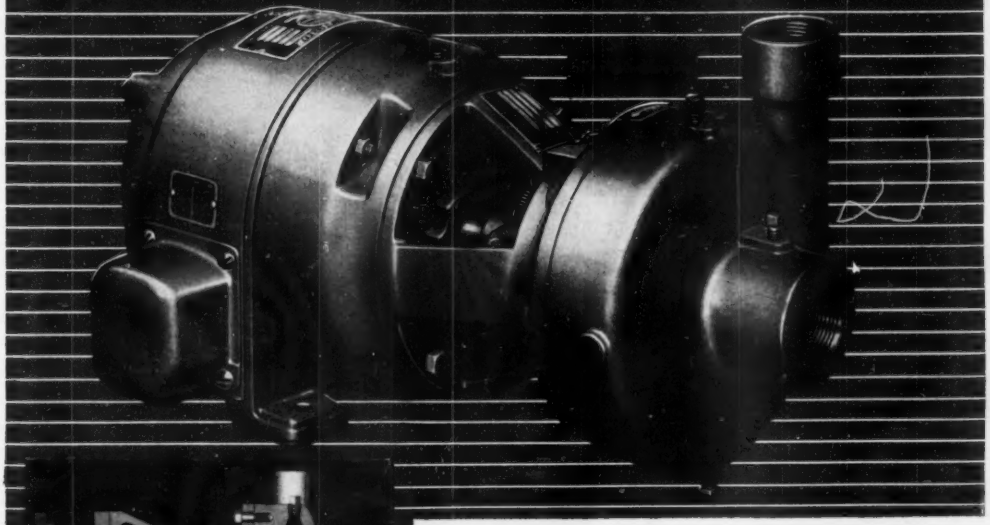
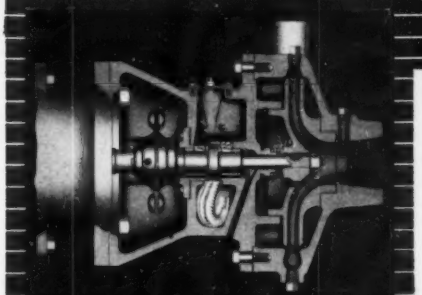
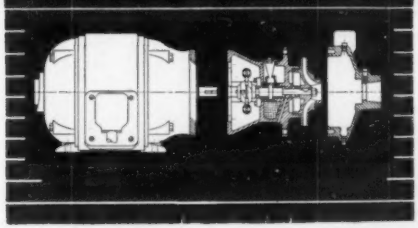
Worth looking into...

SEE THE 8 REASONS WHY B & G SERIES 1522 PUMP DOES A BETTER JOB







When you check into these design features, it's easy to understand why B & G Series 1522 Pumps are making performance records . . .

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Hydraulically balanced impeller.

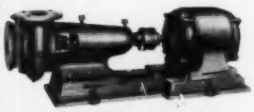
Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

Fifth: Interchangeable parts. The bearing bracket sub-assembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all B & G 1522 Pumps.

Sixth: Shaft alignment maintained by oil-lubricated, high grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's stocks.

Eighth: With all these features, B & G Pumps are *competitively priced!* Don't delay—get the facts *now* on B & G Centrifugal Pumps.



B & G Series 1510-15 Centrifugal Pump

B & G Series 1531 Centrifugal Pump

Send today for catalogs giving descriptions and selection data for B & G Centrifugal Pumps.

Heat Exchangers . . . Water Heaters
Pumps . . . Refrigeration Equipment
Forced Hot Water Heating Systems

BELL & GOSSETT

COMPANY

Dept. CP-36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto

remove the cause

...end the trouble

Take the oxygen from your boiler feed water and you put an end to costly oxygen corrosion. You spend less for repairs . . . get more hours of service from your steam power plant.

Monsanto Santosite (sodium sulfite anhydrous, technical) takes *all* oxygen from boiler water. It is safe . . . easy to use . . . economical. Santosite removes oxygen by combining with it to form harmless sodium sulfate. Neither Santosite nor sodium sulfate forms sludge or otherwise damages boilers or pipes.

Santosite is available in small or large quantities from jobbers throughout the country. For information on the use of Santosite in boiler feed water, write for Monsanto Technical Bulletin No. O-26, "Santosite for Removing Oxygen from Boiler Feed Water." MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 S. Second Street, St. Louis 4, Missouri.

Santosite: Reg. U. S. Pat. Off.

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CHEMICALS—PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

For Dependable Flow Control
Specify POWELL VALVES

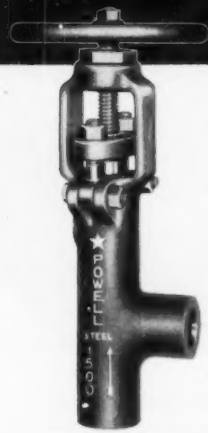


Fig. 1333-A—Steel Integral Bonnet Angle Valve for 1500 pounds W. P. Socket weld ends. Sizes ½" to 2", incl.

Because Powell Valves are engineered to meet the specific conditions under which they must operate, they have an established reputation for long, dependable performance with minimum maintenance.

The Powell Line for Power Plants includes Gate, Globe, Angle, Check and Non-Return Valves in all required sizes—Bronze and Iron for the lower pressures and Cast Steel for high temperatures and pressures from 125 through 2500 pounds. In Cast Steel, in addition to bolted bonnet valves of all types, Powell makes outstanding lines of Pressure Seal and Integral Bonnet Valves.

The Wm. Powell Co., Cincinnati 22, Ohio

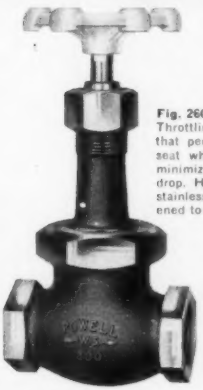


Fig. 2608—200-pound Bronze Globe Throttling Valve. A Powell design that permits FULL FLOW through seat when wide open, thus greatly minimizing turbulence and pressure drop. Has special bronze stem and stainless steel disc and seat hardened to approximately 500 Brinell.

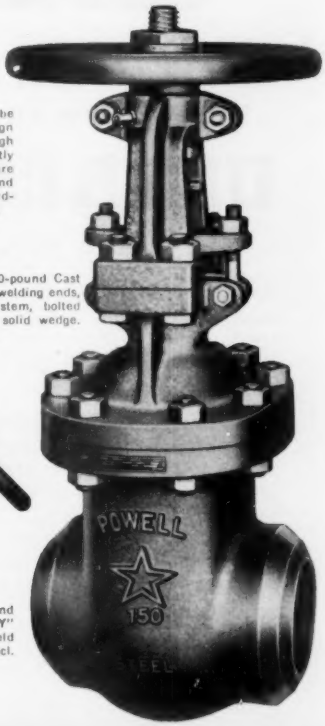


Fig. 1503 W. E. — 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

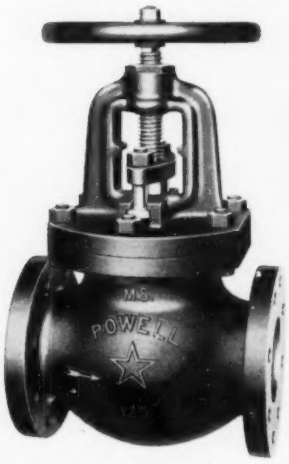
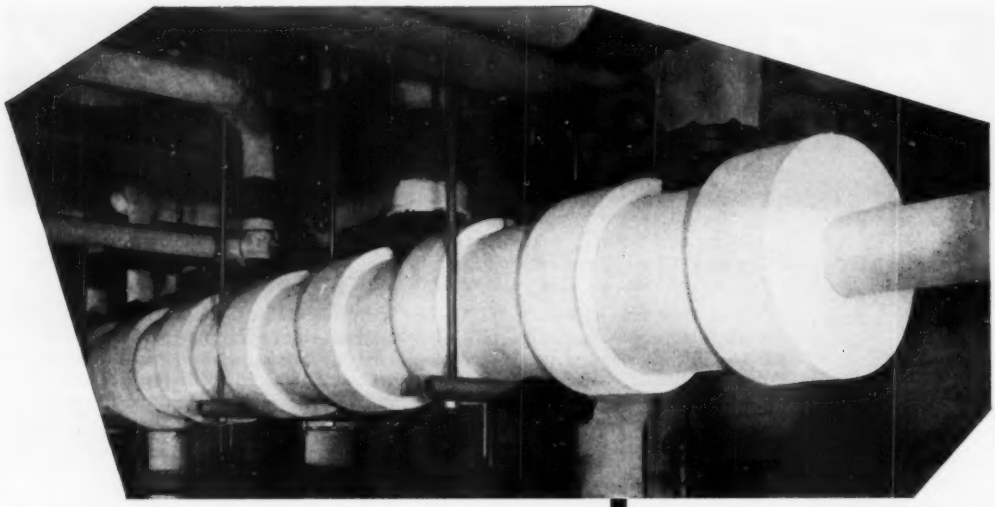


Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Sizes 2" to 16", incl. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

Fig. 1314-A — 1500-pound Steel Integral Bonnet "Y" Valve with socket weld ends. Sizes ½" to 2", incl.

POWELL VALVES

In Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys.



MAKE TOUGH JOBS EASY
WITH EASY-TO-USE

UNIBESTOS®

PIPE INSULATION

Ask any user about Unibestos! He'll tell you how easily this good insulation is cut and fit on-the-job, for Unibestos is light, strong, firm—saws cleanly for tight joints—retains initial high efficiency. It is unaffected by service hazards.

Whether you specify Unibestos No. 1200 (for temperatures up to 1200°F.), Unibestos No. 750 (for temperatures up to 750°F.), or Amocel for commercial uses (temperatures up to 600°F.), you'll always save in two ways: (1) quick and simple application; (2) long-lived durability. Your Unarco Distributor can supply you quickly from his stocks of these pipe insulations. Also available in block form for temperatures up to 1200°.

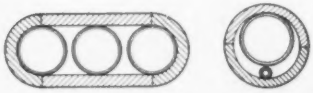
For details on these insulations, ask for Bulletin No. 76-109.

UNARCO

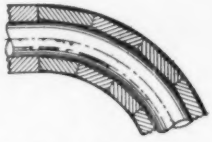
Write for the name of the Unarco Warehousing Distributor in your area.

SEE HOW THESE TYPICAL APPLICATIONS ARE SIMPLIFIED

Unibestos pipe insulation is particularly adaptable for insulating irregular surfaces such as flanges, valves, and fittings. Its firmness and easy-to-fit characteristics make such jobs easy; save time.



Unibestos pipe insulation and block can be used separately or in combination for insulating nested and traced lines quickly and economically.



For insulating pipe bends Unibestos can be mitered easily, and cemented-in with Unarco No. 50 insulating cement.

UNION ASBESTOS & RUBBER COMPANY

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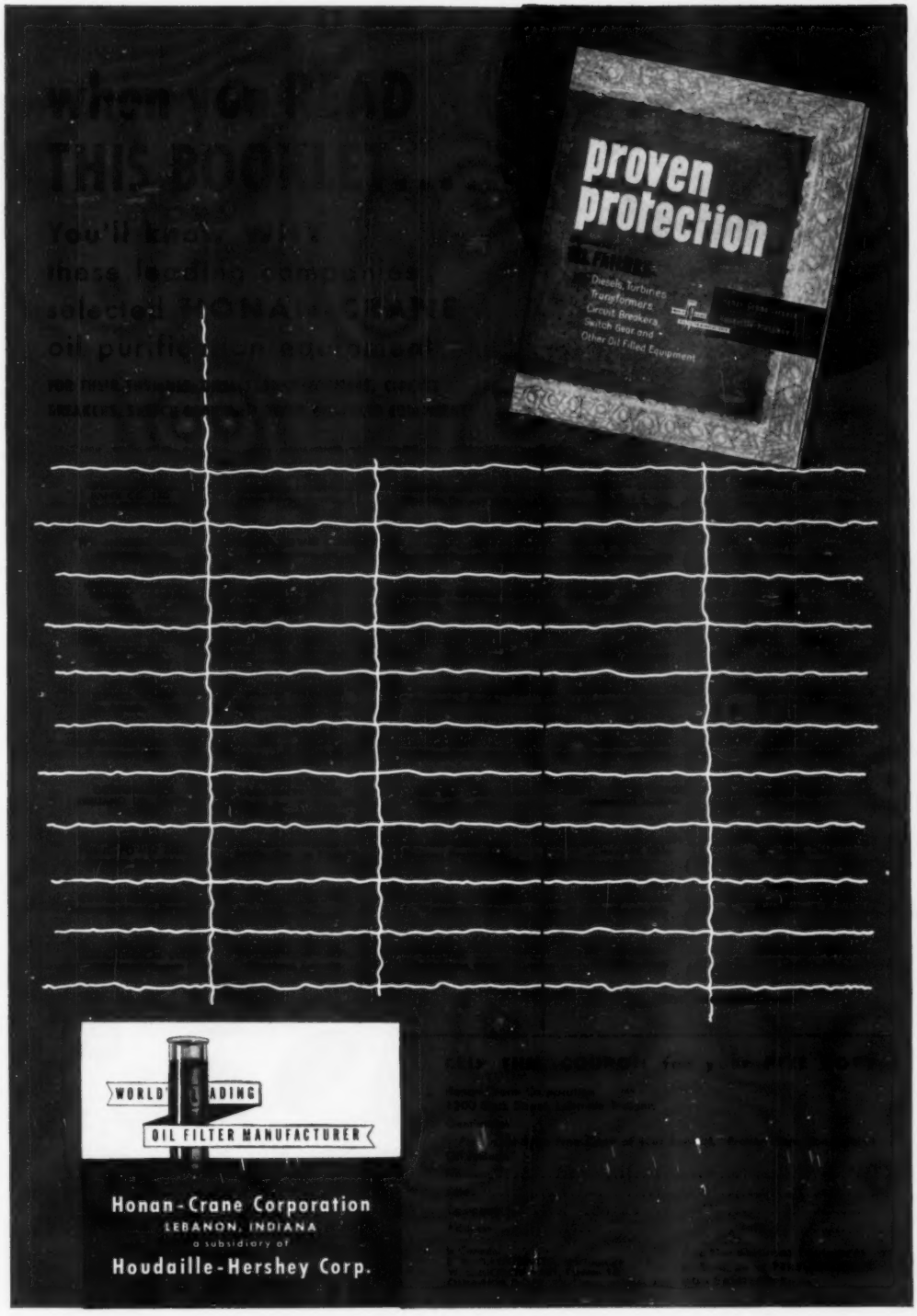
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Other Oil Filled Equipment
WORLD LEADING
OIL FILTER MANUFACTURER
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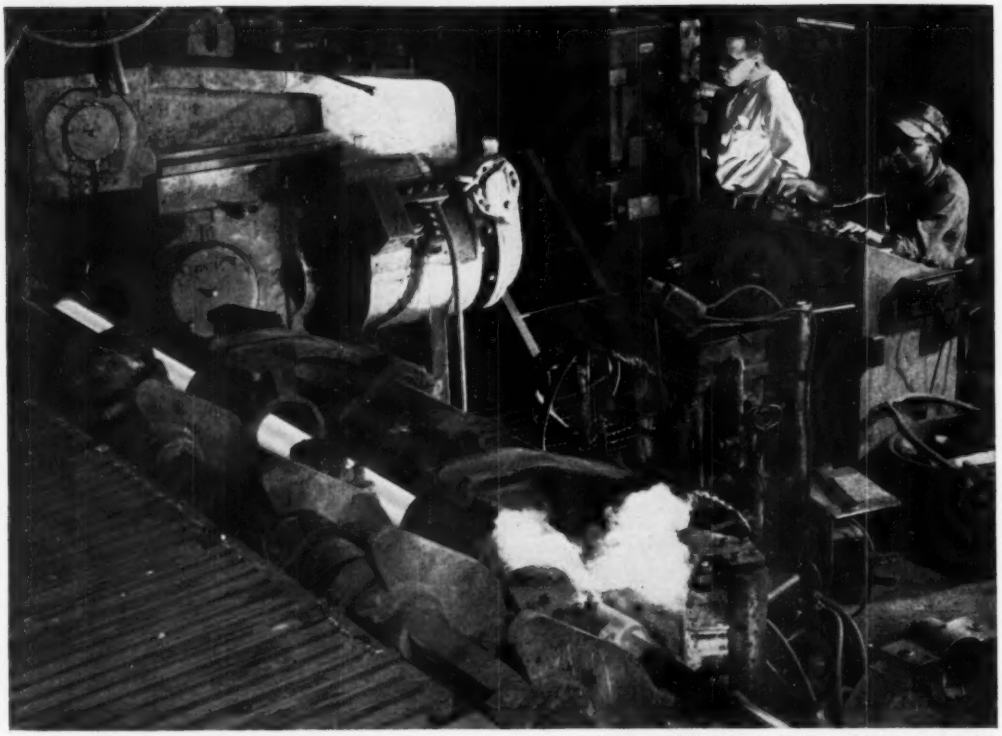
Quality begins with the billet . . .



Here is one of the highly specialized manufacturing operations that insure Globe quality — piercing the billet to form a seamless tube.

only GLOBE welding fittings receive continuous specialized process control from billet, to tube, to fitting

The quality of any welding fitting cannot exceed the quality of the tube from which it is fabricated.

Only Globe — among manufacturers of fittings — produces its own seamless tube. *Specialized* processes at every stage of manufacture — from billet . . . to tube . . . to fitting — insure uniform high quality. Rigid inspection and continuous laboratory controls guarantee strict conformity to rigid specification.

Moreover . . . *you can get these high-quality fittings now* — when you need them. Just get in touch with your nearest Globe Sales office.

For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

GLOBE STEEL TUBES CO., Milwaukee 46, Wisconsin

Chicago • Cleveland • Detroit • Houston • New York • Philadelphia St. Louis • Denver • San Francisco • Glendale, Cal.

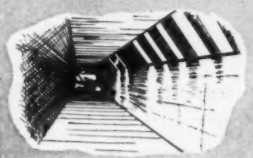
Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high-purity ingot iron) seamless tubes — Globe Welding Fittings.

WHERE TO USE LUMNITE IN POWER PLANTS

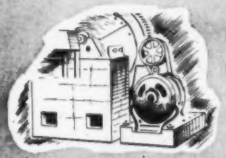
Steel Stack Linings

Ash Pit and Cinder Catcher Linings

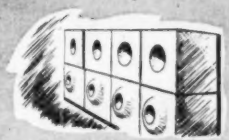
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

FOR RAPID REPAIRS

SAVE TIME, CUT COSTS

with a CASTABLE REFRACTORY

Quickly adaptable to any size, shape or thickness, Castable Refractories made with Lumnite* are economical first aid for emergency repairs.

For baffles, furnace walls, arches, door linings, you get one-piece refractories that reduce heat loss, prevent infiltration of outside air. No shrinkage to bother about. High spalling resistance. Low upkeep.

They're easy to use, too. Add water to the packaged mixture, cast it in place or in a simple form or mold. Large jointless sections are as easy to cast as small special shapes. There's no cutting or fitting. And rapid hardening Lumnite Castables are ready for service in twenty-four hours or less.

You get time-saving, adaptable construction and long, durable service when you specify a Castable Refractory made with Lumnite. You get a balanced, tailor-made refractory that results from the blending of selected materials. You get suitable refractory aggregates with cold-setting, high-strength binder, Lumnite. Castables to meet different temperature and insulation needs are made by manufacturers of refractories and sold by their distributors. For further information, write to Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

P-L-18RR

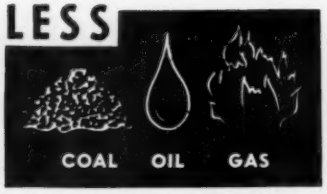
ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—September to June*

When you automatically maintain a constant draft in the combustion chamber, meter the air needed for combustion and regulate fuel feed, you get more steam from your present boiler.

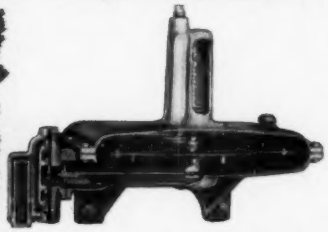


With automatic control you adjust the rate of fuel feed exactly to the load requirements at all times — no over-firing or under-firing — no waste in fuel.

Flue Damper is changed in accordance with furnace conditions to prevent combustion losses due to excess air. No fuel waste at any time.

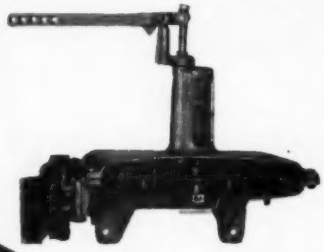
OPERATE YOUR BOILER ROOM *for less* WITH THIS EQUIPMENT

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS



FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



GET this continuous, automatic control in your boiler room and get the savings that come in smaller fuel bills, increased operating efficiency, and reduced maintenance. The units shown here are available in a number of variations — combinations of these units can be made to give you complete automatic control with all of its benefits, whether you have a stoker, pulverizer, oil-burning or gas-firing equipment on your boilers. Size of your boiler or type makes no difference — equip with CASH STANDARD Automatic Combustion Control and you increase its capacity.

GET A QUICK PICTURE OF THE ACCURACY, SIMPLICITY, ECONOMY, AND DEPENDABILITY

Send for Bulletin No. 300

Read the details of how CASH STANDARD Automatic Combustion Control works in your favor. This bulletin fully explains the performance of each unit and shows applications to different types of boilers.

AIR FLOW CONTROLLER

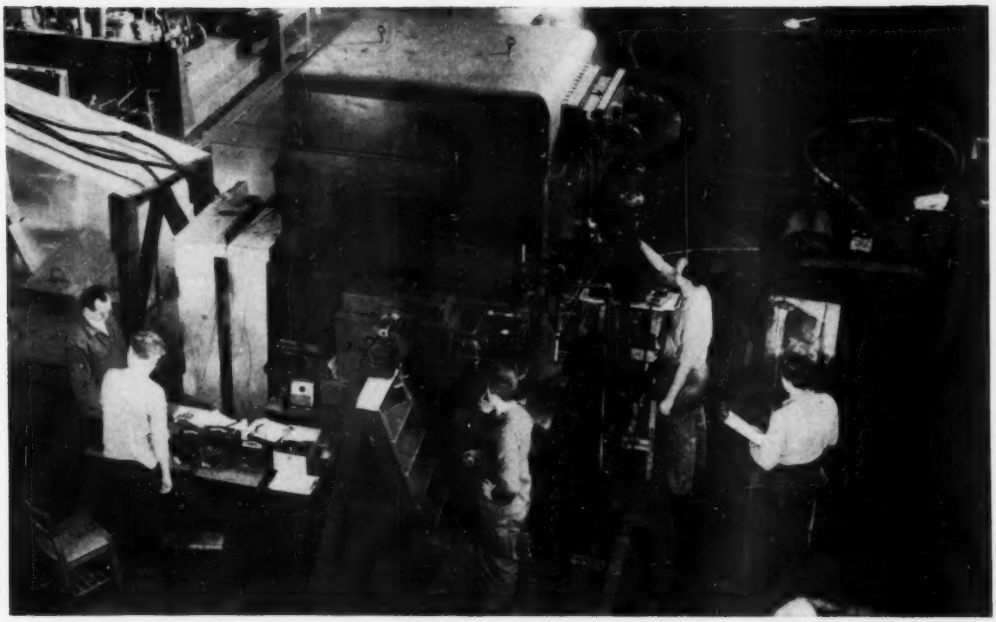
This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES



Totally enclosed 3500 hp motors pass final exam

Final tests are completed on these new 1800 rpm, pedestal bearing type E-M Squirrel-Cage Induction Motors. Among the largest high-speed motors built for pumping, these motors are typical of a trend toward total enclosure in big motor design.

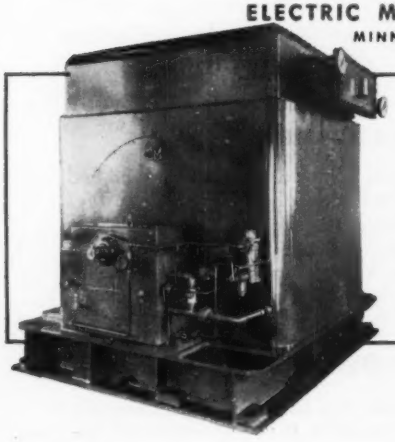
No outside dust or airborne particles reach the motor . . . the sealed recirculating ventilating system limits foreign matter to the small amount already present in the system. Mounted on top of the motor, special air-to-water coolers dissipate motor heat effectively without creating excessive engine room temperatures. Motor interior stays clean and cool, and the total enclosure keeps objectionable noise to a minimum.

A forced-feed bearing lubrication system assures continuous proper lubrication. Specially designed insulation has high dielectric strength, resists moisture effectively. Precise rotor balancing techniques make for smooth running at high speed.

You will find these advantages of E-M totally enclosed motors especially significant where cooling water is readily available, such as on pumps, mixers or rubber mill drives. See your nearest E-M sales engineer for his specific suggestions.

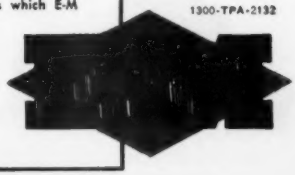
ELECTRIC MACHINERY MFG. COMPANY

MINNEAPOLIS 13, MINNESOTA



FIRST OF TEN...

This is the first of ten 3500 hp, 4160 volt totally enclosed pedestal-type motors which E-M is building. Totally enclosed motors are especially economical in terms of minimum maintenance and continuous service. To find out how E-M engineers solve high-speed induction motor design problems, write for Publication No. 210.



1300-TPA-2132

Specialists in Big Motor engineering

24 ACRES *Cover the World*

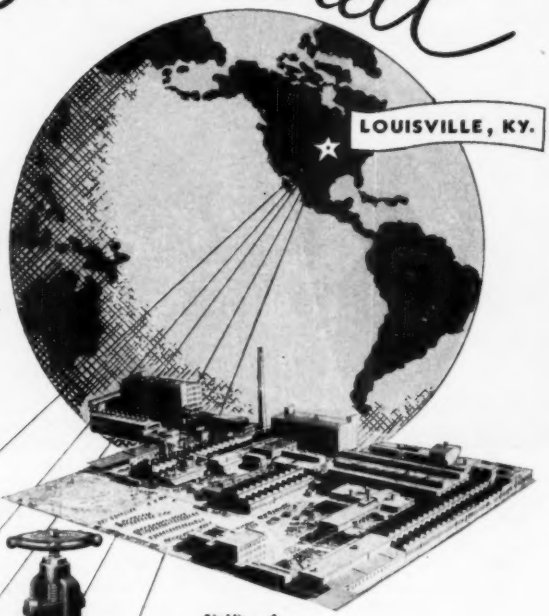
. . . with TOP QUALITY

DROP FORGED STEEL

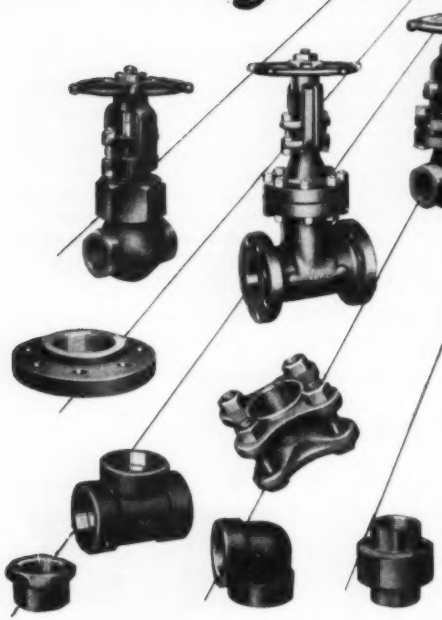
VALVES, FITTINGS and FLANGES

by

Vogt



Air View of
Henry Vogt Machine Co.



This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

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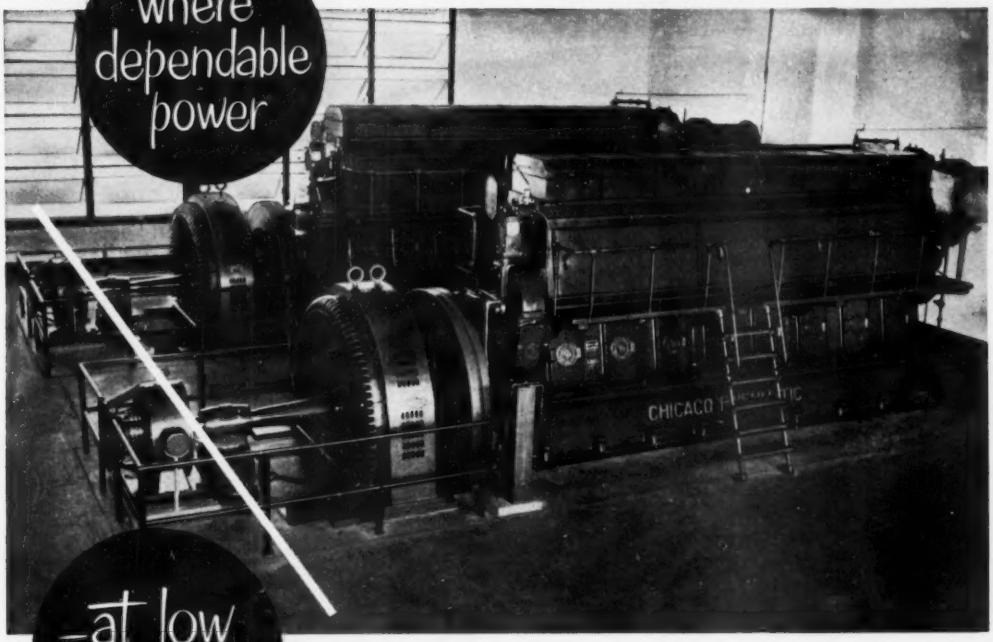
Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

where dependable power

Two CP 1500 hp Diesel Engines in a western public utility station.



-at low cost-

is a "MUST"

CP ENGINES, for straight Diesel, Dual Fuel, or Gas operation, have earned an enviable reputation for providing thoroughly dependable power at low cost. They are widely used in public utility stations, municipal power plants, institutions, petroleum pipeline stations, and in many kinds of industrial plants.

They are particularly suitable for voltage booster stations at the end of long transmission lines; for emergency hook-ups during power line repairs and replacements; for local generating plants in isolated areas; as well as for furnishing power in central stations.

Available in units up to 1750 hp., the CP line includes both normally aspirated engines and supercharged engines incorporating the Elliott Turbocharger.

Fiftieth ANNIVERSARY

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

5,596 ENGINEERS* SPECIFY PEROLIN

Thousands of engineers on land and sea have chosen PEROLIN Fuel Oil Treatment. They have found PEROLIN to be the only product that does the job the way they want it done . . . thoroughly, completely . . . and at a saving, too! They know The Perolin Company, backed by a half century of experience, can be counted on to maintain uniform, high quality and unsurpassed service.

Are you using PEROLIN? If not, we invite you to try it. Compare PEROLIN, the *Complete* Fuel Oil Treatment, with any fuel oil additive on the market. Then judge by actual results the improved efficiency of your boilers . . . and you, too, will join our list of friends and customers.

Write for free technical literature or for name of nearest PEROLIN Service Engineer.

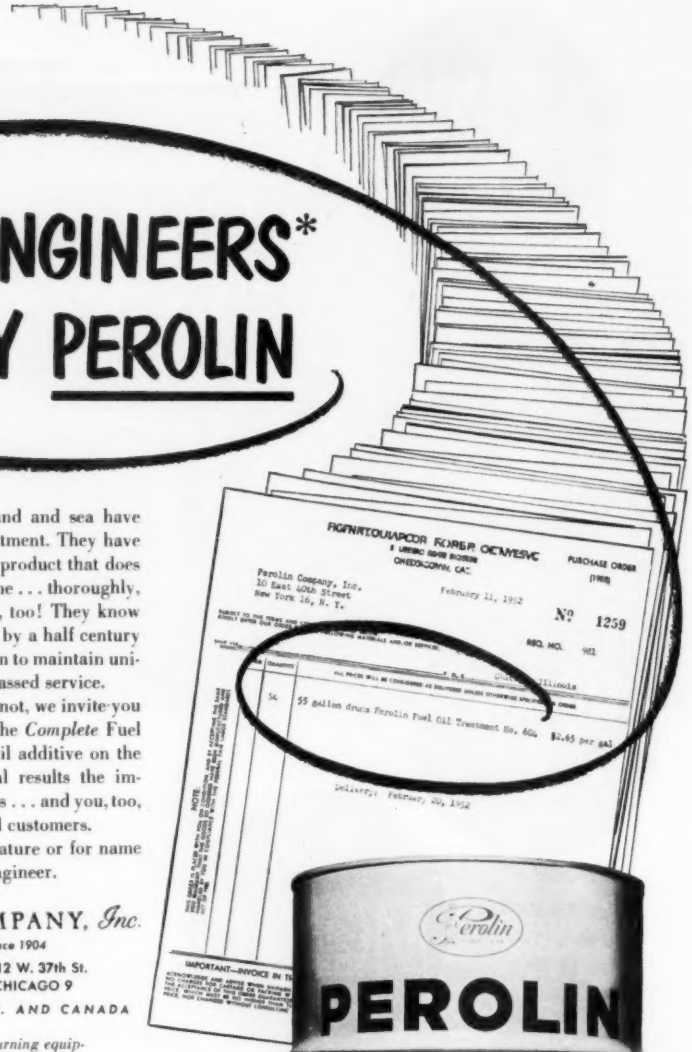
The PEROLIN COMPANY, *Inc.*

Manufacturing Chemists since 1904

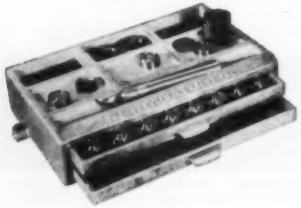
10 E. 40th St. NEW YORK 16 • 1112 W. 37th St. CHICAGO 9

22 WAREHOUSES IN THE U.S. AND CANADA

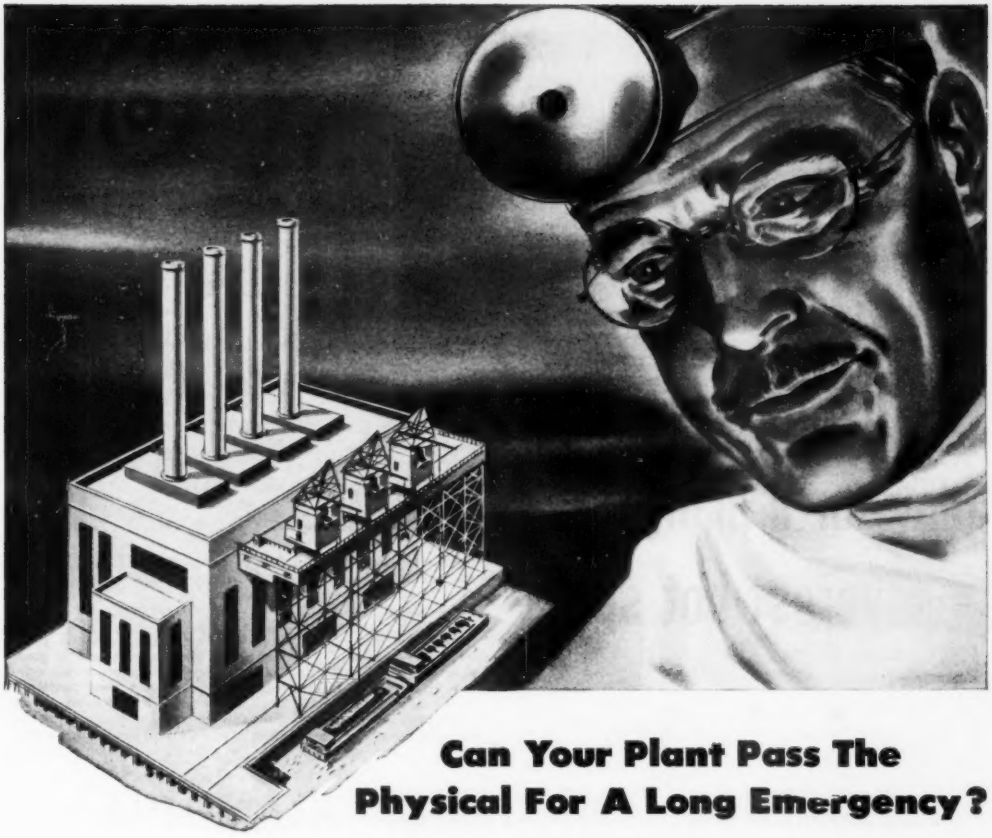
**Men in charge of commercial oil burning equipment in the U.S.A. and Canada, not counting hundreds abroad, as of May 1, 1952.*



Perolin SINCE 1904



FREE to large users of PEROLIN Fuel Oil Treatment—our Tip Kit, for effective and economical burner maintenance.



Can Your Plant Pass The Physical For A Long Emergency?

A "physical exam" for a power station recently revealed that abrasion and corrosion were draining the life out of coal chutes. Chutes were soon "eaten through" in spots . . . only lasted 2-3 years. "Rat-holing" and arching contributed to high maintenance. The cause was partly design, partly materials.

Studies of coal handling resulted in new, more scientific designs—more efficient chute angles . . . improved convergence angles where two streams of coal meet . . . better cross-section designs . . . and similar advances to prevent sticking. Use of stainless-clad steel provided surfaces that work-hardened and polished under use, neutralizing corrosion and abrasion threats. Results? Chute life already doubled and no signs of wear as yet. Feed failure due to stoppage eliminated and costly maintenance a thing of the past.

How can you achieve similar performance? These advances come from combined planning—to assure the best equipment, the engineering staffs of progressive Equipment Builders work closely with design and power engineers and material suppliers. Each contributes his experienced thinking to the total problem. Would you like to talk to builders like these? They turn to Lukens regularly for its knowledge of materials as well as its wide range of low-cost clad steels.

For their names, write us today explaining your problem. Manager, Marketing Service, 585 Lukens Building, Coatesville, Pa.

LUKENS

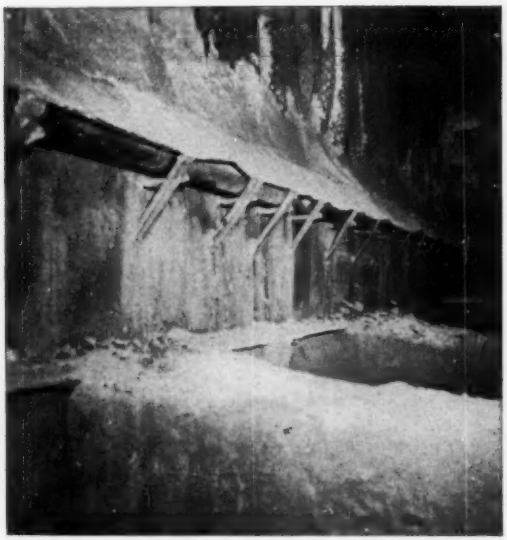
LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

INCONEL...

the heat-resisting alloy for a plant's severest hot spots

★ ★ ★



This "water-back" is one of two used in boilers at Toledo Edison's Acme Plant. Made of ¼-inch Inconel plate, these devices are used to break up and cool molten slag as it slides down the division wall between fire and tube sections of the boiler. One side of the plate is subjected to the 2200° to 2400° F. radiant heat of the molten slag, while a spray of cooling water plays on the reverse side. Thermal shock and abrasion are so great that only a tough, high-strength, high-temperature material like Inconel can survive for long. Previously used materials lasted only three months. Yet Inconel gave 18 months of service—and they went out only after the water spray headers (shown under Inconel Cap sheet) clogged and shut off the cooling water.

This versatile wrought-nickel alloy is serving in many places in the power field where its extra strength and resistance to oxidation at high temperatures are essential.

Inconel® is a structurally stable alloy that does not lose its toughness even after long exposure to high temperatures. It is particularly useful for services involving cyclic heating and cooling, or thermal shock.

Inconel has high impact strength, too. Charpy tests reveal strength of 154 ft.-lbs. at 1400° F.

And its resistance to relaxation or load loss makes it an excellent metal for springs where operating temperatures range from 500° to 650° F.

You'll find that Inconel is workable both hot and cold. It is machinable and can be joined by the usual welding, brazing and soldering processes.

You can get all the essential engineering data on Inconel from Technical Bulletin T-7, "Engineering Properties of Inconel." Write for your free copy today.

And remember, Inconel, like other nickel alloys, is on extended delivery because of defense. Therefore, it is important to include your NPA rating and complete end-use information with all orders.

The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Nickel INCO Alloys

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL® INCONEL "X"® • INCOLOY • NIMONICS

Specify HAGAN

AUTOMATIC COMBUSTION CONTROLS

and you specify dependable accuracy and reliable performance, year after year

Remember: Waste as little as one percent of the fuel burned during the life of your boiler, and the cost of the wasted fuel can equal five, six, or even seven times the original cost of the control system!

From this point of view alone, you cannot afford anything less than the best—Hagan Automatic Combustion Controls.

Let our engineers put their years of experience with all types of combustion control applications to work for you.

For full information, wire, write or call:

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

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BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMATIC AND
AERONAUTICAL TESTING LABORATORIES

HOW TO GET THE RIGHT PAINT FOR ONE-COAT COVERAGE

New, free book brings industrial painting facts up to date. We don't make paint. But to help you get full value from the paint you buy, we'll send you this fact-packed book on aluminum paints. Read it before you plan another paint job. It can save you time and dollars.

You may know that aluminum paint is best for many places in your plant. But do you know what *kind* of aluminum paint is best for each job? Some are specially formulated for painting metal and masonry, others for wood, others for heated surfaces. Mail the coupon for the free book that answers these and hundreds of other paint questions.

SEND FOR FREE BOOK

ALUMINUM COMPANY OF AMERICA,
Paint Service Bureau, 1794-H Gulf Bldg., Pittsburgh 19, Pennsylvania.

Please rush me free copy of "Painting with Aluminum."

Name (please print)_____

Address_____

City_____ State_____

We plan to paint the following_____

Look for this shield on aluminum paints made by many paint manufacturers using ALCOA PIGMENTS.

ALCOA ALUMINUM

ALBERON ®

Coming next month

"WATER"

A special editorial section of 48 pages.

Fully illustrated, it explains the facts of this most important raw material of industry.

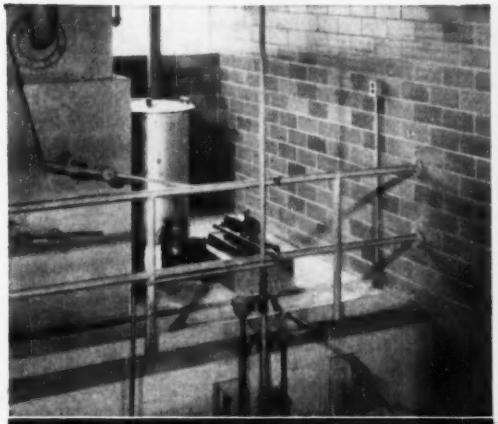
Don't miss "Water" in your copy of September POWER.

●

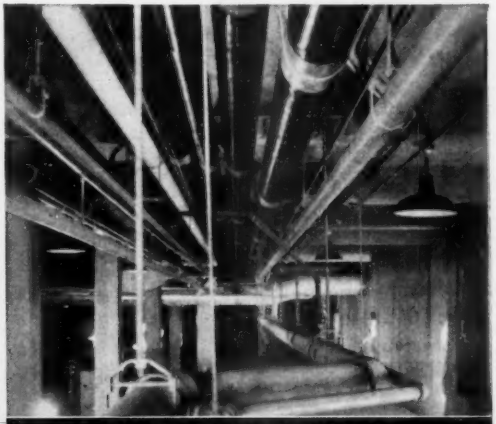
Reprints will be available after publication—as long as supply lasts. One dollar each. Quantity prices on request.

Dearborn provides water conditioning

for GREATER Pittsburgh airport



BOILER HOUSE—Dearborn 53HA Tank and Type "N" Pump for continuous feeding of Formula 702* to boiler feed lines to eliminate return line corrosion.



HOT AND CHILLED WATER RETURN LINES—Fiberglas covered with NO-OX-IDized Wrapper No. 4 completely insulates piping.

Larger than La Guardia Field and Washington's National Airport combined, the new Greater Pittsburgh Airport is now serving air-minded America. Architectural innovations in the design of the seven story terminal building will serve as an airport model for years to come. Dearborn is proud of its part, the development of a water treatment program and pipeline protection for costly heating and air conditioning equipment installed in this magnificent masterpiece.

Specialists in Industrial Water Treatment and Rust Prevention since 1887, Dearborn gives you a *complete* service (1) analysis of your requirements (2) the correct formulas and equipment to apply them (3) proper test control procedure. Take advantage of Dearborn experience on your next job . . . call in a Dearborn Engineer for consultation. Bulletins sent on request.

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois

*U. S. PAT. 2400543

FLUOR COUNTERFLO AIR CONDITIONING TOWER—Water treated with Formula 846 eliminates scale and corrosion. Formula 517 is used in the closed section for the same purpose.

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza, Chicago 54, Ill.

- ☐ Send me Bulletin 5000 on Dearborn Industrial Water Treatment.
- ☐ Bulletin on NO-OX-ID Rust Preventives.
- ☐ Please have a Dearborn Sales Engineer call.

Name.....

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City.....*Zone*.....*State*.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

air is expensive

IN THE WRONG PLACE

Air mixed with the steam in your heaters or coils is expensive because it retards heat transfer and lowers steam temperature. Remove air from steam heated machines with ***Sarco thermostatic air vents.*** Write for Bulletin 276 and the name of the Sarco man nearest you. He can help you select the best vent for your purpose and the right place to install it.

Represented in Principal Cities 502

SARCO SARCO COMPANY, INC.
Empire State Bldg., New York 1, N.Y.
SAVES STEAM SARCO CANADA, LTD., TORONTO 8, ONTARIO

WHERE CAN YOU USE A VARIABLE VOLTAGE ADJUSTOR

35 YEARS OF ENGINEERING PROGRESS ESTABLISHED 1917

• Bulletin VA-180 gives complete specifications of Acme Electric Variable Voltage Regulators in ratings from 150 watts to 10 KVA. Write for copy.

Many industrial maintenance and operating problems can be quickly solved by the installation of a Variable Voltage Adjustor to manually control a low voltage or fluctuating voltage circuit. This is particularly true where a voltage drop at electrically powered equipment, located a considerable distance from a transformer, reduces the performance, efficiency and prevents normal operation. If you have a condition like this in your plant write for Bulletin VA-180.

ACME ELECTRIC CORPORATION
468 WATER ST. CUBA, N.Y.

Acme ACME Electric
TRANSFORMERS

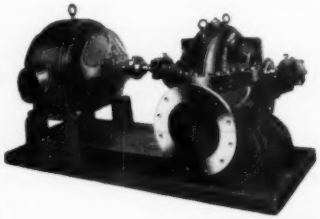
"Buffalo" *Tips on Better Pumping*

REDUCE FIRST COST BY CHOOSING TOP RECOMMENDED PUMP SPEED

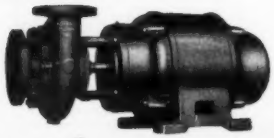
Generally, the higher the operating speed, the smaller the pump you need for a given capacity. This saves on first cost and critical materials so badly needed today. On the other hand, ordering a pump on the basis of having a large margin of capacity can result in purchasing a wastefully large pump. This is why it is so important to give your pump supplier all possible facts about your pumping job—specific gravity, temperature and chemical analysis of liquid to be pumped, discharge head in feet, gallons per minute.

A Caution

OVERSPEEDING a pump naturally shortens its life, and is even more wasteful than using an oversize pump. Thus, the driver speed should be in line with the supplier's recommendation. "Buffalo" engineers are ready to advise you as to the right pump for your expected conditions—a quality-built "Buffalo" Pump of the exact size and construction consistent with best service and economy on the job. Write us *today* about your pumping problem!



Left, "Buffalo" Class "SL" Double Suction for efficient clear water service. 10 to 14,000 gpm capacities. Write for Bulletin 955-P.



Right, "Buffalo" Close-Coupled Pumps are compact, durable and assure permanent shaft alignment. Bulletin 975-B.

"Buffalo" **BUFFALO PUMPS, INC.**
488 BROADWAY BUFFALO, N.Y.
Subsidiary of Buffalo Forge Company
Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Use This Economical STUD for HIGH-TEMPERATURE BOLTING

The easiest way to prove the economy of the Bethlehem Continuous-Thread Stud is to give it a real trial, in bolting jobs involving high temperatures or high pressures, or both. You'll soon discover that this is a stud that can take it, and that down-time caused by stud breakage becomes virtually non-existent.

The Bethlehem Continuous-Thread Stud gives a good account of itself in difficult bolting applications because of its ability to minimize stress-concentrations. As the stud has no point of thread-runout, those stresses which do occur are well distributed over the entire length of the stud, and therefore cannot concentrate at any one point.

The Bethlehem Continuous-Thread Stud is made from carbon or alloy steels, and comes either plain or heat-treated. It is furnished in a wide range of diameters and in virtually any length, with many sizes carried in stock.

If you have any questions about the range of applications for which the Bethlehem Continuous-Thread Stud is best suited, put them up to the nearest Bethlehem office. Or write to us at Bethlehem, Pa.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

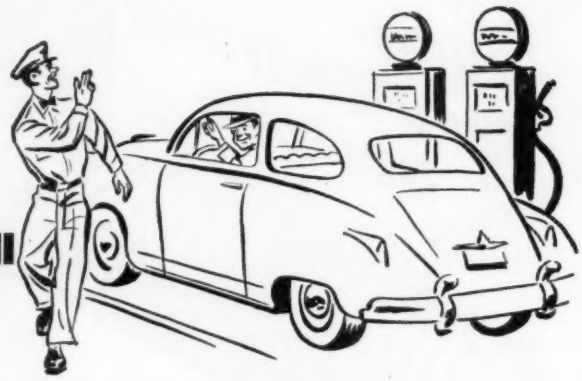
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Bethlehem supplies every type of Fastener

"SEE YOU AT THE POLLS!"

"SEE YOU AT THE POLLS!"

"SEE YOU AT THE POLLS!"



Nobody knows for sure how it started—this line about "See you at the Polls!" we're hearing all over these days.

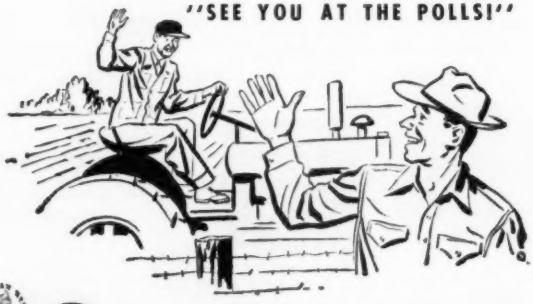
Best explanation seems to be that it came from that state candidate out west. . . . His opponent in a debate got all riled up and challenged him to fight it out in the alley.

But he said—"I'll settle this the AMERICAN way—I'll see you at the polls!" And the audience picked up the chant.

Now everybody's saying it—and on Nov. 4 everybody will be *doing* it!

"SEE YOU AT THE POLLS!"

"SEE YOU AT THE POLLS!"



POWER

Now you can have GREATER PIPE LINE MOTION CONTROL IN A MORE COMPACT, LESS COSTLY EXPANSION JOINT!

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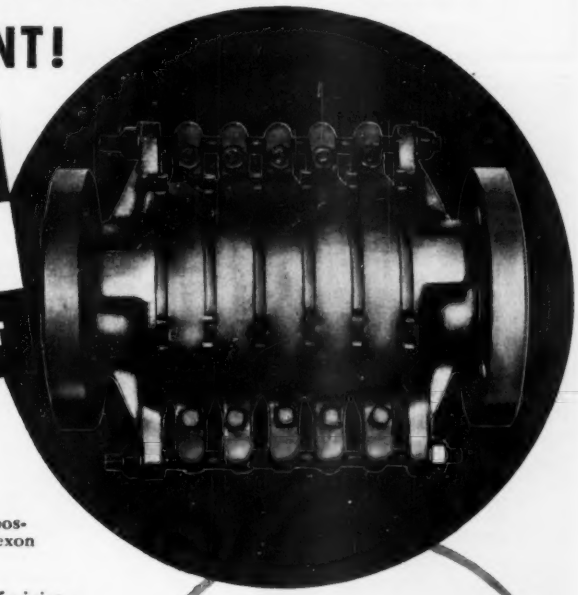

Continuing research and development at Flexonics Corporation have now made it possible to offer design improvements in Flexon Expansion Joints that provide three basic advantages:

1. The face-to-face (over-all) dimension of a joint to handle a given amount of expansion has been reduced.
2. The reduction in size results in a lower expansion joint cost to handle a given amount of motion.
3. Exhaustive tests prove that these joints provide a maximum of motion commensurate with optimum life.

Coupled with such accepted advantages as compactness, ease of installation and freedom from maintenance, these additional advantages make Flexon Expansion Joints the most satisfactory method of controlling pipe line motion for the majority of installations.

Complete specifications are given in the new Flexon Expansion Joint Bulletin. Check this data before you select or specify expansion joints for your plant. Write for your copy, today.

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FREE FLEXING—Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 30 psi, temperatures from minus 100°F. to 800°F.

CONTROLLED FLEXING—(Illustrated above) Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 300 psi, temperatures from minus 100°F. to 800°F.

FLEXONIFLEX—Integral ring type. Available in sizes from 1/8" pipe through 6" pipe. Suitable for pressures to 5500 psi, temperatures from minus 400°F. to 1600°F.

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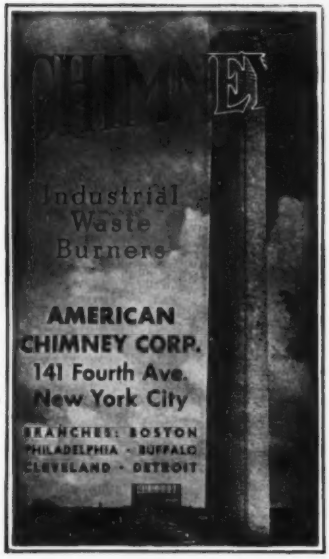
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

WHERE TO BUY

Featuring additional products, specialties & services for power plants



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A Good Habit

This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in the power generation and transmission field. Make a habit of checking this page each issue.

(His business paper . . . of course)

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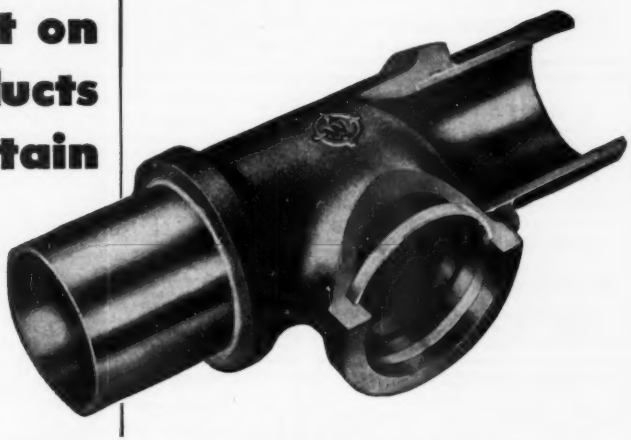
POWER

One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

F-69

DON'T BE SATISFIED WITH HALF-WAY MEASURES...

insist on Walseal® products and be certain



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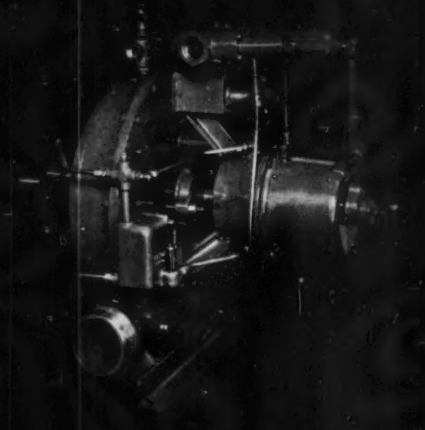
Wing



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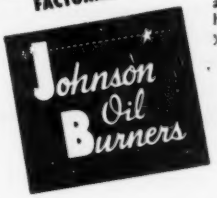

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Aid or Trade?
A CRISIS AHEAD

A crisis in the foreign trade relations of the United States is in the offing. It is a crisis caused by:

1. Efforts of producers in friendly nations to earn more dollars by increasing exports to the United States, and
2. Efforts of industries in the United States which would be hurt by competition from these imports to keep them out.

This crisis is a threat to the effectiveness of American leadership in the crucial effort to build the nations of the free world into a strong and unified group. It is the purpose of this editorial to advocate a constructive approach to the difficult situation that is developing.

Background of the Crisis

Most countries in the free world—with American aid—have managed to push their outputs well above prewar levels. As they have done so, they have been urged by our highest government officials to increase their exports to us. Sales in our market enable these countries to earn dollars which they use in turn to buy the products of America's farms and factories. Thus, as they become self-supporting, the need of American aid is reduced.

But as these efforts to export more to the United States have promised increasing success, competitive American producers have become increasingly alarmed about what that success might do to them. Consequently, they are seeking more protection—by appeals to the U. S. Tariff Commission to recommend higher import duties and by appeals to Congress for new laws to discourage imports.

Our Friends Protest

A year ago Congress answered one of these appeals by imposing a quota on imports of dairy products. Now, among many other legislative proposals being strenuously pressed is a move to extend the scope of "Buy American" legislation. A year ago the U. S. Tariff Commission had only four petitions for increased import duties on its docket. Since then fourteen more petitions have been filed and others are definitely on the way.

Faced by these mounting efforts to block the sale of their products in the American market, no less than eleven friendly nations, including Great Britain, France, Italy, Canada, the Netherlands, Switzerland and Denmark, have filed protests with our State Department. Through many of the protests runs one refrain. Although stated in diplomatic language, it might be correctly paraphrased to say: *"In*

sending us aid you have made it very clear that you want us to get on a self-supporting basis at the earliest possible moment. But, when we begin to make headway in that direction by trying to sell you more of the things we are equipped to produce, you start closing your market to us." The threat of European resentment against the United States being stirred up by this argument is obviously great.

At the same time there exist grounds for special resentment in the United States against certain prospective imports of European manufactured goods – those of machine tools, for example. In part these will be produced with machinery that has been sent to Europe as part of our economic aid program. With absolutely no diplomatic language involved, the argument, which will be extended much farther than the facts would justify, will run: "*We gave those people the equipment that they now use to cut our throats!*" This line of argument will find response among workers as well as employers in industries faced by more competition from imports. Labor, too, is keen for protection against more foreign competition.

Aid or Trade?

As between continuing direct economic aid to Europe or accepting the imports that would make those countries self-supporting, some would prefer to continue the aid program. They argue that the tax machinery of the federal government can spread the burden of aid broadly, while we have no comparable machinery that can cushion the shock to individual industries, firms and communities that may result from stepped-up imports of competitive products.

As we see it, this position is untenable. It would make rubbish of our Atlantic Charter promise ". . . to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity." It would be an admission that, for all our profession of faith in competition and our opposition to European cartels, we really don't believe in competition.

U. S. Self-Interest

The people of this country have invested billions of dollars and seven years of hard work in the attempt to put our allies on a self-supporting basis. If we keep their goods out by raising trade barriers, we are directly defeating our own purposes.

Also, in moving to protect some groups of American producers we should be hurting others. For many American producers the export market, which this year will take about $14 billion of civilian goods, spells the difference between operating at capacity and closing down 25% of their facilities. When we discourage imports we cut off dollar earnings by other nations which are spent here to keep some of our factories and farms going.

At the same time, it must be recognized that certain American industries and their capacity to maintain employment will be hurt by increased imports. Hence it becomes critically important for the United States to formulate a national program designed to help these industries and communities take up the shock.

There is no neat and simple prescription by which this can be done, but several possibilities have been suggested. One on which there is general agreement is that tariff reductions should be gradual. To cushion their impact, the government might well give preference on defense orders to industries and areas adversely affected by an increased volume of imports. Direct assistance to workers and companies in shifting to different lines of business may be worth consideration.

These are by no means all the possibilities. They may not even be the best. But they do serve to suggest the necessity for flexibility and imagination in dealing with the growing crisis in trade relations. *Our ingenuity in developing new ideas to meet this crisis may well be a decisive factor in our effort to weld the free nations into a strong and durable alliance.*

McGraw-Hill Publishing Company, Inc.

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For modern new high pressure steam electric generating plant in the Southwest area of the United States. Prefer graduate mechanical engineer, or equivalent, with adequate experience and qualifications to assume complete supervision of plant operation and maintenance. Good working conditions and opportunity for advancement. Preferred age 35 to 45 years. All applications will be acknowledged. Salary commensurate with qualifications. Please send personal record to

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GENERAL ENGINEERS GS-11, $5940 per annum —Duties: Head of Facilities Branch, Power Plants Division, Engineeering Dpartment. Directs the preparation of plans, procurement and installation of new rocket test facilities and equipment, and the modification of existing facilities and equipment as required for specialized tests. Applicants should complete Standard Form #57, Application for Federal Employment, which is available at any post office, and forward to the Industrial Relations Officer, Industrial Relations Department, U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, New Jersey.

GENERAL ENGINEER GS-9, $5060 per annum —Duties: Project engineer in the Facilities Branch, Power Plants Division, Engineering Department. Makes plans, procures and installs facilities and equipment for the testing of rockets and components. Applicants should complete Standard Form #57, Application for Federal Employment, which is available at any post office, and forward to the Industrial Relations Officer, Industrial Relations Department, U.S. Naval Air Rocket Test Station, Lake Denmark, Dover, New Jersey.

MECHANICAL ENGINEER Established Southwestern Utility desires a liaison engineer to represent it on the engineering and construction of a 60,000 KW steam electric station. Successful applicant must be familiar with all phases of design and construction of large steam plant. B.S. in engineering degree required, plant operating experience desirable. This is a permanent position. Salary open. P-4772, Power.

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(Continued on page 280)

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2668 CLYBOURN AVE., CHICAGO 14, ILLINOIS

WANTED
2300/3/60 MOTOR

Approximately 2500 H.P. with control, low speed synchronous preferred. Would consider slip ring.

SOUL CLINIC, INC.
CALGARY, ALBERTA, CANADA

THE TRADE MARK WITH A MEANING
SUCCESSFUL OPERATION GUARANTEED
44th YEAR OF SERVICE—MEMBER OF A.R.A.*

MOTOR GENERATOR SET
3 ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800/4000
2	2000*	G.E.	500	600	6600/11000
3	1500	G.E.	514	250	13200
1	1500	G.E.	720	600	6600/13200
1	1500	Whse.	600	600	2300/4600
1	1500	G.E.	360	275	2200/4400
1	1500	G.E.	600	600	2300/4150
2	1000	Whse.	900	600	2300/4150
1	1000	G.E.	900	280	4000
1	1000(3U)	G.E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	600	G.E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	900	250	6600/13200
1	500	Whse.	1300	125/250	2300
1	500	G.E.	720	125	2300/4000
1	400	G.E.	720	250	440/2300
1	400	Whse.	1300	250	2300
1	350	G.E.	900	125	2300/4150
1	300	A.C.	1200	125/250	2200
1	150	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	600	125/250	2300
1	125	G.E.	1200	125	440
1	100	Delco	1300	125/250	440
1	75	G.E.	1200	125	4000
1	75	G.E.	1200	250	440
1	40	Whse.	1200	250	220

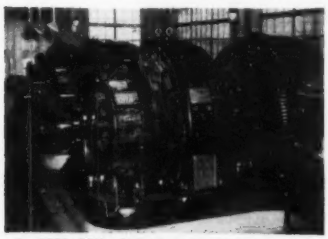
*25 Cycle

ROTARY CONVERTERS

1—2000	G.E.	514	600		13800
1—1000	Whse.	900	600		11000

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	6000	Al. Ch.	Condensing 200/350 ISP 2300/3/60-Exc. & Surface Cond.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
2	1000	G.E.	Non-condensing. 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G.E.	Condensing 425#-725°TT ISP-440 V. 3 ph. 60 cy New—1944
1	500	Moore	Non-condensing — 150/200 lbs. ISP 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter
2	500	G.E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60.
1	400	Whse.	Non-condensing 125/150# ISP 5/10# G.B.P., 240/480v. 3 ph. 60 cy.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240 V. 3 ph. 60 cy.



3—1500 KW—250 V. D.C.—13200 V. A.C.
NOW AVAILABLE.

D. C. MOTORS

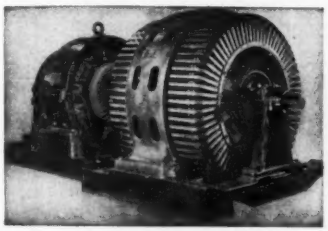
Qu.	HP	Make	Type	Volts	Speed
1—	2200	G.E.	MCF	600	360/500
1—	1750	West.		600	525/720
1—	1500	Whse.		525	600
1—	940	Whse.	QM-B. Brg.	250	140/170
1—	800/1000	Whse.		450	600/720
1—	600	Al. Ch.	MILL	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G.E.	MCF	550	300/1050
1—	300/400	G.E.	DTNA	250	1325/2500
1—	350	Cr. Wh.	CCM-151H	220	1100
1—	335	Whse.	MQ	250	300/900
1—	200/300	G.E.	MPC	230	360/920
1—	250	G.E.	MPC	230	400/500
1—	200	Rel.	1070T	230	720
1—	150	G.E.		600	250/750
10—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
2—	150	Whse.	SK-151 B	230	900/1800
1—	50/120	G.E.	MPC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
2—	80	El. Dy.	308	230	475/1350
1—	60	El. Dy.	208L	230	750/1500

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—3600		G.E.	25/60	4000/2300x2300/4000
1—2000		G.E.	25/82½	2300/4160
1—2000		Whse.	25/82½	2300/2300
1—1000		G.E.	25/58	4400/2300
1— 500		A.C.	25/60	11000/2300V

SYNCHRONOUS CONDENSERS

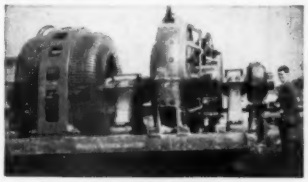
Qu.	Kva	Make	Volts	Speed
1	5000	Whse.	2400/4800	600



500 KW MG SET
IN STOCK

TRANSFORMERS
60 Cycles

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	Whse.	Furnace	3	26400/13200x199
3	2000	G.E.	HVDDJ	1	66000x13800
3	1000	G.E.	H	1	2300x480
3	1250	G.E.	H	1	6600x550
1	1150	A.C.	OISC	3	13200x2300/480
3	500	Al. Ch.	OISC	1	11500x5500
1	500	Whse.	OISC	3	13400x116
9	300	G.E.	HT	3	2400x240/480
3	200	Wagner	OISC	1	13800x230/460
3	150	Whse.	OISC	1	33000x2300/4000
3	150	Whse.	OISC	1	34500x230/460
3	100	G.E.	OISC	1	2400x120/240
2	75	Upte	OISC	3	4160x240
1.	50	Kuhn	OISC	3	4160x240



2000 KW—MG SET
IN STOCK

A. C. MOTORS
3 ph. 60 Cycle
SYNCHRONOUS

HP	Make	Type	Volts	Speed
1—4350	Cr. Wh.		4160/13800	514
2—3500	G.E.	TS	2300	257
1—2500	Whse.		2300	720
3—2100	G.E.	ATI	2300	300
2—2000	Whse.		2300	120
2—1750	G.E.	ATI	2300	3600
3— 735	G.E.	ATI	2200/12000	600
1— 500	G.E.	TS 7657	2400/4800	600
1— 450	Whse.	Eng.	2200	1200
1— 450	Whse.		2300	450
2— 350	G.E.	TS	2200	150
1— 300	Whse.		2300	720
1— 150	Whse.		440	600
1— 100	Whse.		550	600
1— 100	F.M.		220	1200
1— 100	E.M.		440	600
1— 65	G.E.	TS	440	1200

SLIP RING

1—1500	ABB		2300	720
1— 500	Whse.	CW	550	350
2— 500	G.E. unused	M-574Y	2200	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM	440	600
1— 400	Whse.	CW	440	514
1— 350	G.E.	MT442-Y	2200/4000	333
4— 300	G.E.	ITC-5017	550	585
1— 300	Al. Chal.	ANY	2200	700
1— 300	A.C.		440	514
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1750
1— 250	A.C.		550	600
1— 200	Cr. Wh.	26QB	440	505
1— 200	G.E.	IM	440	435
1— 200	G.E.	MTP	440	1170
3— 200	G.E.	IM-17	440	880
1— 200	Whse.	CW	440	490
1— 200	G.E.	IM	440	600
1— 150	new Whse.	CW	2300	450
1— 125	A.C.		440	720
4— 125	G.E.	MT-566Y	440/2300	435
1— 100	G.E.	IM-16	2200	435
1— 100	G.E.	IM	440	600
3— 100	Al. Ch.	ANY	440	695
1— 100	G.E.	MT556	2200	900
1— 75	Whse.	CW-761	2200	1735

SQUIRREL CAGE

2— 650	G.E.	FT550BY	440	3750
1— 450	Whse.	CS	2300/4150	254
1— 300	G.E.	KT-574Y	2300	595
1— 200	G.E.	IK-17	440	580
1— 200	G.E.	KT557	440	1200
1— 200	G.E.	IK	440	885
1— 150	Whse.	CS	440	580
1— 150	Westghse.	CS856B	440	830
1— 125	Whse.	MS	440	685
1— 125	G.E.	KP-TEFC	440	3585
3— 125	Al. Ch.	ARW	2200	1750
1— 100	G.E.	IK-Vert.	2300	450
1— 100	G.E.	KT-513	220/440	1750
2— 100	G.E.	IK	440	580

** American Rebuilders Association — Member Body of A.S.A.*

BELYEA COMPANY, INC.

OFFICE AND SHOP

43 HOWELL ST., JERSEY CITY 6, N. J.

PHONE
JO 2-3334
N. Y. CITY LINE
RE 2-7150

Electrical Equipment - Rebuilt and Guaranteed - Motors - Generators - M-G Sets - Transformers - Controls -

ELECTRICAL EQUIPMENT

REBUILT AND GUARANTEED

PROMPT SHIPMENT — PARTIAL LISTING

Motors - Generators - M-G Sets - Transformers - Controls - Electrical Equipment - Rebuilt and Guaranteed

250 VOLT DYNAMOMETERS

Cradle Type With Scale and Control

Write for Complete Specifications

Qu.	Make	HP	RPM	Type
1	G.E.	150	2200/5000	TLC-50
1	West.	150	2200/5000	SK-131
1	G.E.	200	1200	C

SLIP RING MOTORS—3 Ph., 60 Cy.

Qu.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-320
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
1	15	570	220	West.	CW-646
1	18	680	440	West.	MW-318
1	20	860	440	West.	CW-638
2	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
1	35	600	400	F-M	HV-H16A
2	40	865	2200	Al. Ch.	ARY-223C
1	40	580	440	G.E.	MT-346
1	50	1150	440	G.E.	MT-536
1	50	570	440	G.E.	MT-552
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
1	150	1730	440	G.E.	MTF-549
1	175	600	550	West.	CW-1002
1	200	495	2200	G.E.	IM-17A
1	250	600	2300†	G.E.	IM-17
1	300	900	440	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
1	400	595	550	West.	CW
1	600	1770	440*	G.E.	IM-E15C
1	700	735	4000‡‡	West.	CW

220 volt meters can be reconnected for 440 volts.
‡Intermittent rating. 1225 cycle.
**New. †Also 440 or 550 volts.
-Also 2300 volts.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding. Direct Connected Exciter.

Qu.	KVA	RPM	Make	Volts
2	18.7	1800	Columbia	240/120
4	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D.C. MOTORS

Qu.	HP.	Speed	Make	Type
10	3	850	Reliance	T-23T
6	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-66
2	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
4	10**	1150	Al. Ch.	ED-80
2	10	850	West.	SK-83
10	13½**	600	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	625	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20**	1450	G.E.	CDM-83
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20**	1450	G.E.	CDM-83
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
3	200	1150	G.E.	RC-38
1	250	1150	G.E.	CMC-101

230 VOLT ADJ. SPEED D.C. MOTORS

Qu.	HP.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	12½	280/840	West.	SK-130
1	15	800/1200	West.	SK-100L
1	20	500/1500	G.E.	RF-11
1	20/25	300/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40, 50	400/1200	West.	SK-163
1	75	375/750	Cr. Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
1	100	400/1200	Al. Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	230/800	West.	SK-250
2	375	350/800	G.E.	MPC

**New

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Totally Enclosed Fan Cooled, Ball Bearing

Qu.	HP	RPM	Volts	Make	Type
4	2	1140	220	L.A.	JS-225Y
3	3	1160	440	L.A.	JS-254
4	5	1730	440	G.E.	K-254
2	7.5	1740	440	G.E.	K-284
1	10	1735	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

SPLASHPROOF, BALL BEARING

Qu.	HP	RPM	Volts	Make	Type
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
4	15	1150	440	L.A.	FX-365
1	50	1780	440	L.A.	FX-445A
4	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
2	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335

OPEN TYPE MOTORS

Qu.	HP	Speed	Volts	Make	Type
3	10	3500	440	G.E.	KT-56
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KT-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
1	25**	875	440	Master	PB-405
1	25	575	440	G.E.	KT-542
3	30	3560	550	G.E.	K-3648
1	30	1755	220	G.E.	FT-513
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
2	60*	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
2	75	1775	440	West.	CS-505
2	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-3528
1	100	600	2200	West.	CS-930
1	100	495	2200	Al.Ch.	AN
8	125	1750	2200	Al.-Ch.	AR
1	125	435	440	Al.Ch.	AR
1	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2200	West.	CS-39A
1	500	1200	140	G.E.	KTF-567
1	700	1900	2300/ 4000	West.	CS-4-39D12

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

MOTOR GENERATOR SETS

125 and 250 Volts D.C.

(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	280/2201
10	West.	1750	125	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
16	West.	1750	125	2200/440
25	G.E.	1200	125	220/440
30	Al. Ch.	1750	125	220/440
50	West.	1200	2/40	2200
50	G.E.	1720	125	220/2401
75	G.E.*	1200	125	220/240
100	West.	1160	125/250	2300/4100

Note: 3KW, 5KW & 7.5KW, 250V Sets Available
*New *Synch. Motor Driven. ‡50 Cy. †25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVENUE • CLEVELAND 14, OHIO

43rd YEAR —:— 43rd YEAR

MOTORS & GENERATORS, etc.

1 YEAR GUARANTEE

Partial Listing Only!

GENERATORS—250 V. D.C.

KW	Make	Type	Speed
500	G.E.	MFC	900
300 (2)	G.E.	CY-272	1200
300	Elliott		1200
250	Cr. Wh.	Syn.	1200
200	Delco		1200
150	West.	SK	900
135 (2)	G.E.	MPC	1200
100	West.	SK	1200
75 (2)	Cr. Wh.		1200
50	West.	SK	900
40	West.	SK	1150
40	ABBee	5VG3	1150
30	G.E.	TCG3-4	1800
25	G.E.	RC	1150
20	Watten	D	1150
15	Star		1750
10	G.E.	RC	1150
7½	West.	SK	1750

GENERATORS—125 V. D.C.

KW	Make	Type	Speed
150 (2)	West.	SK	1200
100	El. Mchy.	651-T	1200
100	G.E.	RC	1200
100 (3)	West.	SK	900
100	G.E.	MPC	900
75	G.E.	DLC	1150
60 (2)	West.	SK	1800
50	G.E.	RC	1150
50	Cr. Wh.	CCD	1180

LOW VOLTAGE D.C.

Amp.	Make	Voltage
10000	J-L	7/10
7500 (2)	Nor.	7½
5000	RVW	6
2500	Chandev.	6/12
500	Chandev.	12
1500	Century	24
500	West.	32
1000	Century	32
1000	Chandev.	40
1500	Century	40
1500	G.E.	50
1000	G.E.	60
1000	G.E.	75

JUST PURCHASED

350—230v. D.C. Motors

Over 6200 Total H.P.

G.E.—WEST.—RELIANCE, etc.

Speeds 500 to 1750 RPM

2—150 HP	6—40 HP	75—10 HP
1—125 HP	2—30 HP	78— 7½ HP
12—100 HP	1—25 HP	21— 5 HP
10— 75 HP	29—20 HP	22— 2 HP
2— 60 HP	55—15 HP	51— 1 & 1½ HP

MOTORS—Squirrel Cage

H.P.	Make	Type	Speed
250	G.E.	KT559	1750
200	Wagner	RP-2	1800
200	G.E.	KF	880
200 (2)	Al. Ch.	AR	870
200	G.E.	KS	700
150	Wagner	31VRN	900
150	West.	CS	600
125	Al. Ch. (5)	AR	1760
125	G.E.	IK	1150
100	G.E.	KT	1800
100	G.E.	IK	1750
100	West.	CS	1750
100 (2)	Al. Ch.	AR	1150
100	G.E.	K	1175
100	West.		870
75 (3)	West.	CS	1750
75	G.E.	KT	900
75	West.	CS	720

MOTORS—Slip Ring

H.P.	Make	Type	Speed
500	Elliott		1180
500 (2)	G.E.	IM	450
400	G.E.	IM	900
400	West.	CW	435
250	G.E.	IM	435
200 (2)	G.E.	IM	1170
200	G.E.	MT	1175
125	West.	CW	1750
100	G.E.	MT	1150
75	Lincoln		1750
75	G.E.	MT	900
75	West.	CW	690
60	G.E.	MT	1720
60	West.	CW	580

MOTORS—Synchronous

H.P.	Make	Speed
475	West.	720
200	G.E.	900
200 (3)	West.	900
200	Burke	900
180	G.E.	900
165	G.E.	1200
150	G.E.	900
150	G.E.	720
75	G.E.	900

Please Send Us Your Inquiries

L. J. LAND, INC.

Established 1910

150 GRAND STREET, NEW YORK 13, N. Y.

CAnal 6-6976

"THE O'BRIEN STORY"

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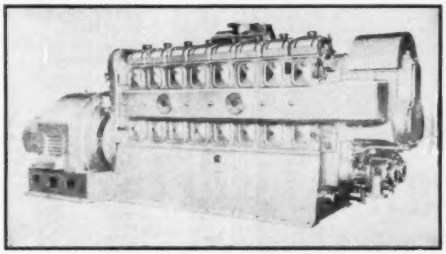
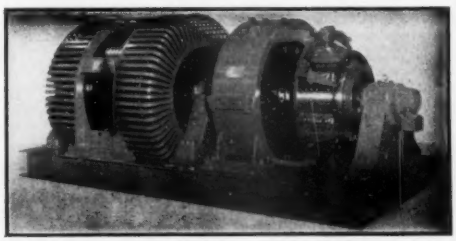
The fact that in whatever corner of the United States you might be, you would be within easy reach of O'Brien distribution and service facilities, confirms the acceptance of O'Brien rebuilt machinery and power plant equipment by thousands of satisfied users all over the nation. With a competent, dependable service organization that is linked from coast to coast, O'Brien can service their machinery throughout the entire United States. This means that you can expect precision performance, economical operation and long life from every completely rebuilt O'Brien machine—each thoroughly reconditioned and tested in O'Brien's own shops and O'Brien guaranteed. We have available now the new, used or guaranteed rebuilt machinery you need to expand modernize, or re-convert quickly, and with minimum capital expense. Inquire today for prices and delivery!

Read more about "The O'Brien Story" in the next issue of Power



375 KVA GM DIESEL GENERATOR SET



500 KW WEST. MOTOR GENERATOR SET

MOTOR GENERATOR SETS

1—1500 KW GE MPC 300 V 5000 Amp.—2150 HP ATI-Syn Motor, 3/60/4000 Volt. Available immediately.
1—1000 KW West. 250 volt Flat Compound 500 RPM 1440 H.P. West. Syn. Mtr. .8 P.F. 3/25 cycle 2300 V. A.C. & D.C. Panels.
1—500 KW Westinghouse 250 Volt 900 RPM with 720 H.P. West. Syn. Motors 3/60/6600/13200 volt, Serial #813047 (year 1935) See actual photo above.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/6/2300 V. A.C. & D.C. Panels.
1—400 KW West. 500 Volt D.C. Any A.C. Voltage with 500 HP West. 350 RPM, 500 Volt Motor for complete drive.
1—360 KW GE CY 125, 180 V., Sep. Exc., 1200 RPM, 500 HP Syn. Mtr., 3/60/2300, 1942.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
1—300 KW Elliott 250 Volt 1200 RPM with 500 H.P. Syn. Motor 3/60/2300/1200 RPM —Automatic Controller & D.C. Panel.
2—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels.
1—100 KW Al. Ch., 250 V. 1200 RPM 150 H.P. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW G.E.—C.D.—125 Volt D.C. 150 HP GE Syn. Mtr., 3/60/220/440/1200 RPM.
1—75 KW Burke 250 V., 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
2—60 KW GE 500 Volt DC, 75 HP, 3/60/440/1200 RPM.
Smaller Sizes and Types—Advise Requirements

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	4000	GE	33000	13200	1
3	1000	GE	13200	2300	1
3	1000	West.	33000	2300	1
1	1000	Penna.	13200	480	1
1	1100	West.	4400	440	3
2	833	GE.	13800	460	1
3	750	West.	2300	230	1
3	500	GE	13200	2300	1
3	333	GE	2400	480	1
3	333	GE	13200	2300	1
3	250	West.	13200	2300	1
3	200	GE	7200	120/240	1
3	200	GE	13200	2300	1
3	200	Mal.	2300	220/440	1
3	200	GE	13200	2300	1
3	200	GE	7200	2300	1
3	150	GE	33000	220/440	1
3	150	Nigg.	2400	240/480	1
3	100	West.	11000	480	1
3	100	GE	7200	120/240	1
2	100	GE	2300	115/230	1
3	75	Mal.	2300	115/230	1
3	50	GE	13200	120/240	1
3	50	GE	13200	2300	1
4	37½	West.	2400	240/480	1
3	25	West.	2300	115/230	1
3	25	West.	6900	2300	1
2	15	GE	2400	120/240	1
3	10	GE	220	110	1
10	1½	GE	2400	120/240	1

DIESEL & GASOLINE GENERATOR SETS

1—937 K.V.A. GM 12 Cyl. New Engine. Rebuilt Gen. 3/60/480 or 2300.
1—625 K.V.A. Baldwin Series 600—New 1948 —1500 hours. 3/60/2300/514 RPM.
2—438 K.V.A. GM—West. 3/60/2200 360 RPM —New 1937. Complete Plant.
1—375 K.V.A. GM 8-268A, 3/60/480/1200 RPM
1—300 K.W. GM New 8-268A, 230 DC.
1—250 K.V.A. GM Twin 6-71, 3/60/220/440.
1—125 K.V.A. Hercules. 3/60/220/440/1500 Hrs
1—62.5 K.V.A. Cummins 6 Cyl. 3/60/220/440.
1—56 K.V.A. Climax Gasoline. 3/60/220/1200.
2—45 K.V.A. Chry. New 6 Cyl. 3/60/220/440.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1000	West.	CW	2300	450
2	600	West.	CS	2200	600
1	500	AC	ARX	2300	1800
3	500	West.	CS	6600	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
1	315	G.E.	Syn.	2200	720
1	200	West.	Syn.	2300	1200
1	150	Ideal	Syn.	220	1200
1	125	West.	Syn. (3 brg.)	550	600
1	125	Cent.	SC	440	1803
2	100	G.E.	Syn.	440	300
1	75	West.	CW	440	1200
1	50	West.	CS	440	3600

TURBO GENERATORS

1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—500 KVA West. Non-Cond. 3/60/220/440, 150 PSI 10 lb. B.P.
2—375 KVA West. Non-Cond. 3/60/440, 125 PSI 5 B.P. New 1938.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—187 KVA West. Non-Cond. New 1936 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—12,000 CFM I.R. Turbo 3.25 lb., direct 250 H.P., 440/3/60/3600.
1—5600 CFM I.R. PRE-2, 42/25½x30, 100 lb. direct 930 HP Syn. 1 P.F. 2300/60/3.
1—4690 CFM I.R. PRE-2 48/24x27 100 lb. direct 804 HP Syn. .8 PF 2300/60/3.
1—3000 CFM GE Turbo 5 lb. direct 90 HP 440/3/60/3600.
2—1400 CFM Sullivan WJ 3 Angle Cpd. 100 psi 22/15x16 belt.
2—1200 CFM I.R. 22/13x16 100 psi belt.
1—900 CFM CP 100 lb. 9CP Portable Diesel Compressor, Pneu. tires.
1—734 CFM Sullivan W-13 13/13x8 60 lb. belt.
1—528 CFM CP NSB 14x12 100 lb.
1—371 CFM Schramm 7¼/6x4 100 lb.
1—368 CFM I.R. ER-1 12x100 100 psi.
1—350 CFM I.R. type 40 7/6¼x5 air cooled 125 lb. direct 75 HP 220/440/60/3 870.
1—396 CFM Sullivan type WL-60 100 psi.
1—215 CFM Penna. 3A 10x8 50 lb.
1—173 CFM CP NSB 9x8 100 lb.
1—173 CFM Penna. 3A 9x8 100 lb.
1—122 CFM Worthington 7x7 Horiz. 100 lb.
1—89 CFM CP 6x7 TB 150 lb.
1—40 CFM I.R. Type 30 80 lb. Tank mtd. 7½ HP
3—21 CFM Curtis CJ-1000, 3 stage 850 lb.
5—16.86 I.R. Type 30, 5½/2x5 400 lb.
100—10 CFM I.R. Type N 26 lb. or 25" Hg. Vac.

"Everything from a Pulley to a Powerhouse"

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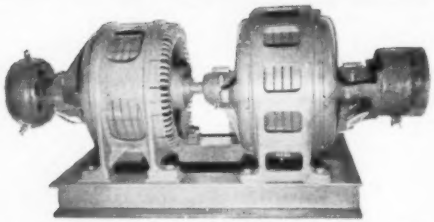

Photo of special 500 KVA AC synch. M-G set—engineered, rebuilt and assembled in our shop—shipped to Mexico for operation of electric pipewelding machine. Complete control panels included.

"Check with WAGNER FIRST"

Complete shop facilities—Dynamic Balancing—Dynamometer Testing—plus a large selection of fine equipment—these are among the many advantages when you buy Wagner "Certified Rebuilt". Save Time & Money Safely!

PARTIAL LISTING OF LARGER ITEMS IN STOCK

A. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
750	Whse.	Synch.	2200,4000	900
700	G.E.	Synch.	2200	514
500	G.E.	Sq. cage	6600/4000	1800
500	G.E.	Sq. cage	440	3600
500	G.E.	Synch.	440	900
500	G.E.	Slipring	220/440	450
500	Al. Ch.	Synch.	440	400
450	Whse.	Synch.	2300	900
350	G.E.	Slipring	440	720
300	G.E.	Sq. cage	2300	1800
300	Whse.	Synch.	2200/440	600
300	G.E.	Slipring	2300	1800
300	Al. Ch.	Slipring	440	360
250	Whse.	Sq. cage	2200/440	1200
250	G.E.	Sq. cage	440	600
250	Al. Ch.	Slipring	2300	514
250	L.A. (2)	Sq. cage	2200	1800
225	E.M.	Synch.	440	1800
225	G.E.	Synch.	2300	900
225	G.E.	Synch.	220/440	600
200	G.E.	Slipring	220/440	360
200	F.M. bb	Slipring	2300	900
200	Cr. Wh.	Slipring	220/440	600
200	G.E.	Sq. cage	220/440	1800
200	Rel. b.b.	Sq. cage	220/440	1200
200	E.M.	Synch.	220/440	514
160	Whse.	Synch.	220/440	600
150	Al. Ch.	Slipring	2200/440	720
150	G.E.	Sq. cage	2200/440	720
150	G.E.	Slipring	220/440	450

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn. cond.		4000/2300	900
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
600	Gen. Elec.	ATB	480	900
500	El. Machy.		240/480	1200
500	Gen. Elec.	ATB	480	900
485	Allis. Ch.	1 brg.	480	400
350	El. Machy.	1 phase	240/480	1200
312	Gen. Elec.	ATB	240/480	600
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
225	Gen. Elec.	ATB	2300	900
225	Gen. Elec.	ATB	240/480	600
150	Whse.		2300/480	600
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900

M-G SETS

KW	Mfr.	Input V	Output V
500	G.E. HCC conv.	2300 AC	275 DC
300	Allis Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis Ch.	440 AC	350 DC
200	Whse.*	2300 AC	275 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.*	2300 AC	275 DC
150	Whse.*	220/440 AC	125/250 DC
105	Century b.b.	220/440 AC	70 DC
100	G.E.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
100	Allis Ch.*	220/440 AC	50 DC
75	Whse.*	220/440 AC	250 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Allis Ch. (2)	220/440 AC	125/250 DC
45	Gen. Elec.*	220/440 AC	60 DC
40	Whse.	220/440 AC	125 DC
40	Gen. Elec.	220/440 AC	250 DC
35	C.W. b.b.	220/440 AC	125 DC
25	Whse.	220/440 AC	125 DC
25	Reliance	220/440 AC	350 DC
20	Whse.	220/440 AC	600 DC
21	Whse.	220/440 AC	35 DC
17	Gen. Elec.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec.	MPC	275	700
300	Whse.	SK	600	900
250	Allis Ch. b.b.	EW	250	1200
150	Whse.	SK191	125/250	900
125	Gen. Elec.	RC38	250	675
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
100	Allis Ch.	E	125	1200
60	Gen. Elec.	LC	250	700
50	Allis Ch. (2)	EW	125/250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	250	1000
300	Gen. Elec.	MPC	230	500
200	Reliance	1400T	230	850
150	Reliance	1050T	230	1200
150	Gen. Elec.	RC39	230	550
150	Gen. Elec.	MPC	230	500/1200
100	Gen. Elec.	C	230	575/1000
60/75	Gen. Elec.	C	230	500/1200
60	Cont. b.b.	D107X	230	1150
50	Gen. Elec.	CD123	230	550/1200

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Arthur Wagner Co.

1435 W. RANDOLPH ST. MOnroe 6-7409 CHICAGO 7, ILLINOIS

TRANSFORMERS

60 Cy. Single and 3 Phase

KVA	Make	Voltages Pri. Volts	Sec. Volts
6000(1)	Am. Br. Bov.	2400	5040/4800Y
3750(1)	Uptegraff	22000	600
3750(1)	Uptegraff	22000	440
3000(1)	Uptegraff	22000	440
3000(1)	GE	22000	480
3000(1)	Uptegraff	22000	550
2500(3)	West.	27600	2300
1250(3)	GE	33000/11000	2200
1000	West.	2200	220
833(2)	GE	13800	460
833(3)	West.	2300	575
800(3)	GE	22000	2300
750(4)	GE	2200	244/488
667(3)	GE	13200	2300/4000
667(1)	Al. Ch.	13200	480
500(2)	GE	11000	2300
500		4600	460
500(6)	GE	33000	6600/2300
500(6)	GE	6640/11500Y	75/120
450	Uptegraff	11000	460
450(1)	Uptegraff	11000	230
400(3)	GE	2200	244/488
333(1)	GE	22000	2200
333(3)	GE	22000	2200
333(1)	GE	22000	2300
333(2)	GE	11500	115/230
333(3)	GE	11000	2200
333(3)	West.	2400	120/240
300(3)	West.	14520	550/230
300(1)	Pitts.	6600	110
300(3)	Pitts.	2300	115/230
300(2)	GE	2300	115/230/440
250(1)	GE	2400	240/480
250(3)	Mol.	34500	2300
250(3)	GE	2400	240/480
250(1)	Wag.	2200	440
250	West.	463	
200(3)	West.	26400	267
200(4)	West.	13800	278
200(3)	West.	13200	2300
200(3)	Al. Ch.	33000	220/440
200(3)	L.M.	7200	120/240
200(2)	Pitts.	12000	115/230
200(3)	Wag.	2300	230/115
200(3)	GE	2400	120/240
200	GE	495	120/240
200	GE	2200	122/244
200	West.	2300	600
200	GE	11500	460
200	West.	3984	115/230
200	GE	6900	2400
150(1)	West.	6900	120/208
150(3)	West.	14400	600
150(3)	West.	14400	575/230
150(4)	GE	12000	115/230
150(1)	West.	2400	480
150(4)	Packard	4600	230/115
150	GE	2400	240/480
150(3)	GE	2200	110/220
150(3)	Pitts.	7200	115/230
150(3)	GE	4150	120/240
100(4)	Penn.	600	120/240
100(3)	GE	14490	2400/4800
100(2)	Al. Ch.	4600	230/115
100(2)	West.	13200	220
100(4)	Al. Ch.	2400	480
100(2)	Pitts.	2300	230/460
100(1)	West.	2300	230/115
100(4)	Al. Ch.	2300	280/115
100(1)	GE	2300	230/460
100(7)	GE	1980	220/440
100(3)	GE	1100	220/440
100(3)	Pitts.	4600	230/115
100(3)	GE	460	115/230
100	GE	11500	230/460
100	GE	11000	2300
100	GE	2400	120/240

WE STOCK 1200 UNITS 5 TO 75 KVA.

MOTORS • GENERATORS
TRANSFORMERS

25 cy. 60 cy. D.C.

ALL VOLTAGES 1-1500 H.P.

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ELECTRIC EQUIPMENT CO.
ROCHESTER 1, N.Y.

AUGUST, 1952

CHICAGO Electric Digest

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GUARANTEED REBUILT EQUIPMENT AID TO INDUSTRY

SQUIRREL CAGE

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
1000	*G.E.	K6347S	1800
750	*G.E.	KT	720
500	*G.E.	PGB	1800
450	*G.E.	KF567S	1200
400	*Continental	NZ	1200
400	A.C.	ANW	900
400	*G.E.	IK	514
350	*Cr.-Wh.	SC	3600
300	*Westgh.	CS	3600
300	G.E.	IE-K	1200
300	A.C.	AR	900
250	A.C.	630DSWW	1200
250	*L. Allis	OGX1488	720
250	G.E.	IK	600
200	*G.E.	FT549Y	3600
200	*G.E.	IK13B	1800
200	*A.C.		720
200	A.C.	ARWWT	600
200	G.E.	IK17	600
150	G.E.	KT345	1800
150	*A.C.	AN	1800
150	G.E.	IE-K	1800
150	*G.E.	IK	600
125	*A.C.	AR226	1800
100	*G.E.	FT542Z	1800
100	G.E.	FTRP	1800
100	*Westgh.	CS	1800
100	A.C.	AW	1200
100	G.E.	IK15A	1200
100	U.S.	CFU (Vert)	1200
100	*Westgh.	CS (Vert)	1200
100	A.C.	AR	900
100	G.E.	IK15A	514
75	A.C.	AN	1800
75	Westgh.	CS645C	1800
75	G.E.	KT346	1200
75	Westgh.	CS	900
75	A.C.	AR (Vert)	900
75	G.E.	IK	600
75	Triumph	TR16	514
75	G.E.	IK	514
60	*Westgh.	CS504S	1800
60	A.C. APZ445S (TEFC)		1800
60	A.C. APZ504U (TEFC)		1200
60	Armor	AB51	1200
60	A.C.	AR823	900
60	A.C.	AR826F	514
50	G.E.	K404	3600
50	Westgh.	CS445	1800
50	G.E.	KT527	1800
50	U.S. SCV937 (Vert)		1800
50	G.E.	KT343	1200
50	Howell K504 (TEFC)		1200

Hundreds of Smaller Motors!!

D. C. MOTORS

Mill Type—Pedestal Bearing—Reversing

HP	Make	Volts	Speed
3000	West. (Tandem)	525	600
1750	West.	600	550
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

230 Volts—Constant Speed

H.P.	Make	Type	Speed
375	Westgh.	Ped	650
200	Westgh.	SK210	800
175	G. E.	ELC11	750
125	G. E.	Marine	1200
100	G. E.	RC34	2500
100	Westgh.	SK173	850
50	A. C.	E182	575
40	Cr.-Wh.	CMC	1800
40	G. E.	CO2004	500
35	Cr.-Wh.	CM351	700
30	Westgh.	SK93	1750
30	Westgh.	SK120	975
30	Cr.-Wh.	CCM	450
25	G. E.	ED93	1150
25	Westgh.	SK100L	1100

MANY OTHERS—1 HP and Up! Also 115 Volt

CRAFTSMANSHIP MEANS QUALITY

SLIP RING

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
500	Westgh.	CW	350
400	A.C.	3 Brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IM-15	1800
300	*G.E.	MT-410	450
250	Westgh.	HF15H	600
200	Westgh.	CW	600
200	G.E.	IM	1800
150	Westgh.	CW772C	1200
150	*G.E.	IM-16	600
125	*G.E.	MT-549	1800
125	G.E.	IM17A	600
100	A.C.	ANY	900
100	G.E.	IM	450
75	G.E.	MT547	1200
75	G.E.	MT356	900
75	G.E.	IM	720
75	Star	OSOO	900
60	Westgh.	CW762C	900
50	G.E.	IM11A	1800
50	A.C.	ARY	1800
50	Westgh.	CW636A	1200
50	G.E.	MT346	720
50	G.E.	IM	600
50	G.E.	IM14	425
40	G.E.	MT336	1200
40	Westgh.	CW642C	1200
35	G.E.	IM	1200
30	G.E.	MT532	900
25	G.E.	IM11	1200
20	G.E.	MT512	1200
15	L.Al. (new)	OH326	1800

Hundreds of Smaller Motors

HI-PRESSURE

PUMPS

GPM	Make	Type	Head
800	Worth	6DS	925 ft.
500	Manistee	H	250 ft.
300	Al.-Ch.	NMZ	800 ft.

AC SYNCHRONOUS

MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

H.P.	Make	Type	R.F.	Speed
1420	*Westgh.	Syn.	0.7	900
800	G. E.	TS984	1.0	1800
700	*G.E. (New)	TS975Z	1.0	1200
320	*A. C.	Syn.	1.0	720
300	G. E.	ATI	0.8	900
300	*G. E.	ATI	1.0	720
300	*Ideal	SMM	0.8	257
250	*A. C.	Syn.	0.8	720
150	*Westgh.	HR	1.0	300
125	Parkinson	Syn.	0.9	900
125	*El. Ma.	Syn.	1.0	900
125	Cr.-Wh.	103S	1.0	900
125	*G. E.	TS	1.0	277
115	El. Ma.	EM	1.0	240
100	Cr.-Wh.	103S	0.8	900

AC SYNCHRONOUS

GENERATORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 Volts or Higher)

KVA	Make	Type	P.F.	Speed
3500	*G. E.	ATI	0.8	720
1750	*Westgh.		0.7	900
1500	G. E.	ATI	0.8	720
250	*A. C.		0.8	720
112½	*G. E.	ATB	0.8	1200
110	Cr.-Wh.	103	0.8	900
100	*G. E.	ATB	0.8	900
60	F-M	B	0.8	900
55	G. E.	ATB	0.8	1200

PHONE: CANAL 6-2900

CHICAGO Electric Co.

1320 West Cermak Road, Chicago 8, Ill.

CHICAGO ELECTRIC EXPERTS DO OUTSTANDING JOB

For over 42 years, Chicago Electric has been a leader in the rebuilding of electrical power equipment. This record of business is positive testimony to the exacting standards and high quality of the Chicago Electric rebuilding work. Equipment is rebuilt to perform "like new" and fully guaranteed. Whatever your needs be sure to check with Chicago Electric first.

A COMPLETE SERVICE

Chicago Electric offers a complete service to industry that covers, REWINDING, REPAIRING, REBUILDING, REDESIGNING, COILMAKING, SPECIAL MACHINING, POWER SURVEYS POWER-FACTOR CORRECTION and RENTAL of equipment.

M. G. SETS

K.W.	Make	A.C.	D.C.
2400	A-C (3-unit)	4800/2400	525
2400	West. (3-unit)	4800/2400	600
1000	G. E. (3-unit)	11000	137½/275
1000	West. (3-unit)	11000	137½/275
750	A. C.	440	250
500	Al. Ch.	2300	250
500	Cr.-Wh.	220/440	250
450	G. E. (3 unit)	2300	125/250
250	West.-G. E.	440	250
200	Ridgeway	2200	250
150	G. E.	2300/440	250
150	G. E.	440	250/275
100	G. E. (25 cy)	440	125
100	G. E.	2300	250
100	G. E. Delco	440	120/240
75	Al. Ch.	440	250
60	Al. Ch.	2300	110
40	Cr.-Wh.	220	125
35	G. E.	440	125
25	Westgh.	2200	125
20	G. E.-Bogue	440	125
20	G. E.-Bogue	550	250
20	G. E.	440	250
15	G. E.	220	250

DC to AC, 3 Phase, 60 Cycle

KVA	Make	DC	AC
100	G.E.	235	230
75	Westgh	110	2300
12½	Westgh	115	240

ENGINE-GENERATOR SETS

KVA	Make	Type	Volts	RPM
300	Gen. Mot.	8-268A	480	1200
100	Gen. Mot.	3-268A	480	1200
100	Gen. Mot.	671	480	1200
31	Cummins	HI-6	120/208	1200
25	LeRoi	20-A	120	900
10	Onan	PE95G	115/230	1800
1½	Kohler	D-7551	110 DC	1000

TRANSFORMERS

KVA	Make	Ph.	Pri.	Secondary
1000	Westgh.	3	4800	480
850	Westgh.	3	4160	455
450	G.E.	3	2300/4000	230/460
300	G.E.	3	13800	240/480
300	G.E.	3	2400	240/480
200	Wagner	1	2400	575
167	A.C.	1	2400	120/240
100	Pitts.	1	2400	575
100	A.C.	1	2400	120/240

SPECIAL

110 NEW Hi-Torque—Hi-Slip Motors 3/60/220/440, BB, Staright Shaft 1 — 1⅛ — 2 — 3 — 5 — 7½ HP. Speeds —1020 to 1135 RPM. OPEN and TENV. Less than HALF of your usual Cost

MOTORS - M.G. SETS - CONTROL

NEW AND GUARANTEED REBUILT

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
600	1800	2300	G.E.	100%
400	900	2300	Whse	80%
200	900	440	E-M	80%
150	200	440	G.E.	80%
150	600	440	G.E.	150%
150	720	2300	G.E.	80%

SLIP RING

HP	RPM	Volts	Mfg.
500	1200	220/440	Elliott (new)
400	300	2300	G.E.
350	450	2300	Whse.
200	450	2300	Burke
100	1160	440	G.E.
75	720	220	G.E.
50	720	220	Whse.

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	125/250	2300	Whse.
400	125/250	2300	Whse.
300	250	2300	G.E.
150	250	440	Whse.
100	275	2300	Whse.
50	250	440	G.E.
40	250	220/440	G.E.
30	125/250	2300/4000	G.E.
7½VS	250	220/440	Rel.
3VS	250	220/440	Rel.

CRADLE TYPE DYNAMOMETERS

1—225 HP, Whse., 250 v. D.C., 300/2000 RPM, complete with Toledo automatic printing type scale and all necessary control.
1—150 HP, Whse., 275 v. D.C., 3000/5000 RPM, Frame 121, complete with all necessary control.

NEW MAGNETIC SLIP RING CONTROL

1—ALLIS 250 HP, 440 volt (125 HP, 220 volt) Reversing, 7 accel. steps, main line air ckt. brkr., fully magnetic, open or enclosed.

D. C. CONTROLS 230 volts

2—200 HP G.E. magnetic reversing, dynamic braking starters.
1—125 HP Clark magnetic adjustable speed starter.
1—New 100 HP Monitor magnetic, adj. speed starter.
1—Westinghouse 75 HP, reversing, dynamic braking starter.
1—New 75 HP C-H Bul. 6130H92 plain magnetic starters.
3—75 HP Cutler-Hammer plain magnetic starters, NEMA 4 enclosed.
1—50 HP Ward Leonard mag. adj. speed starter, dyn. braking.
2—40 HP G.E., magnetic, reversing, dynamic braking starters.
1—New G.E. 30 HP variable voltage controller CR 3270Y1, reversing, dynamic braking.
1—30 HP G.E. Planer Control CR 4630Y1, reversing, dyn. braking.
1—25 HP Westinghouse Class 8522 magnetic adj. speed starter.
3—5/7½ HP G.E. CR 4065 magnetic, dynamic braking starters.
4—5 HP C-H Bul. 6130 plain magnetic starters.
(We can assemble any type D.C. control to your specifications)

NEW DIRECT CURRENT

230 volt-dripproof

Qu.	HP	RPM	Mfg.	Frame
5	5	850/1700	G.E.	CD-66
3	7½	575/1725	G.E.	CD-77
1	7½	1750	Rel. (TE)	14T
1	10	575/2300	L.A.	4051
1	50	200/800	E-D	50-S

230 V. DIRECT CURRENT

Reconditioned & Guaranteed

HP	RPM	Mfg.	Brgs.
100	450/1350	Whse.	SI.
65	400/1200	Rel.	SI.
50	200/800	E-D	Ball
50	300/900	G.E.	SI.
35	400/1200	Ideal	SI.
30	250/1000	Whse.	S.SI
30	350/1050	Whse.	SI.
30	500/1500	Rel.	Ball
30	600	Whse	SI.
25	300/1200	Rel.	Ball
25	500/1500	C-W	Ball
25	600/1350	Rel.	Ball
20	250/1000	Whse	SI.
20	300/1200	Rel.	Ball
20	500/1500	G.E.	SI.
20	575/1725	G.E.	SI.
15	250/1000	G.E.	SI.
15	300/900	G.E.	Ball
15	400/1600	Whse	SI.
15	575/1725	L.A.	Ball
15	650/1500	G.E.	SI.
15	700/1350	Rel.	Ball
10	300/1200	Whse.	SI.
10	400/1600	Whse.	SI.
10	850	Rel.	Ball
7½	200/1200	Whse. (TE)	Ball
7½	300/900	G.E.	Ball
7½	400/1600	Whse.	Ball
7½	600/1800	Rel. (TE)	Ball
5	400/1200	C-W	SI.
3	850/1700	Rel.	Ball

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

AVAILABLE—450 KVA, 3 phase, 60 cycle SUBSTATION 13200 to 115/230 volts including primary switchgear.
700 also 450 HP 180 rpm 4160 volt UNUSED syn. motor.
1875 KVA condensing turbine unit.
WANTED—1000 KVA 90 or 100 RPM 480 volt 3 phase 60 cycle coupled generator.

H. BLANE JOHNSON & ASSOC.
Application Engineers
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EXCELLENT POWER UNITS

2—125 KVA Westinghouse AC generators, 440 Volts, 277 RPM. Powered by 2 Bruce Mac Beth gas/gasoline engines.
1—150-HP, 225 RPM, Synchronous motor. Real Bargains.

A A A IRON CO.
Canton & Hawkins Sts., Dallas 1, Texas

REBUILT GUARANTEED POWER EQUIPMENT

MOTOR GENERATOR SETS

KW	MAKE	RPM	D.C.	A.C.
750	Al. Ch.	720	250	2300/440
400	West.	720	550	2300/4000
300 (2)	West.	1200	250	2300/4000
300	G.E.	1200	250	2300/4000
200	G.E.	1200	250	2300/4000
150	G.E.	900	550	2300/4000
150	G.E.	1200	250	2300/4000
100	G.E.	1200	250	2300/4000
35	G.E.	1800	125	220/440
15	Ideal	1800	125	220/440

ROTARY CONVERTERS

KW	MAKE	RPM	D.C.	Transformer
500	West.	1200	250	11450/9000
400	West.	1200	250/125	13860
300 (2)	Al. Ch.	1200	250	2300/4000
300	G.E.	600	250	2300/4000
200	G.E.	1200	250	2300/4000

Will rewind above transformers to your requirements

PLATING M-G SETS

6—1500/3000 Amp. 6/12 V.—A.C. Motors

A.C. MOTORS

HP	MAKE	RPM	TYPE	WDG.
400	G.E.	450	MT	S.R.
300	G.E.	450	IM	S.R.
200	G.E.	900	IM	S.R.
150	G.E.	600	ATI	Sys.
100	G.E.	450	IM	S.R.
100	West.	1200	CS	S.C.
100	West.	900		Sys.
100	G.E.	1750	IK	S.C.
80	West.	575	CW	S.R.
50	G.E.	1750	KT	S.C.
50	Al. Ch	1200	AR	S.C.
50	G.E.	900	KT	S.C.
50	G.E.	900	KT	S.C.
50	G.E.	1200	KT	S.C.

TRANSFORMERS 1 PH. 60 CY.

KVA	MAKE	PRI.	SEC.
1—3000 (3 ph)	G.E.	23000	22000
2— 200	Al. Ch.	22000	2300
3— 100	West.	2400	240/480
5— 50	West.	2400	240/480
1— 50	Al. Ch.	2200	110/220
1— 25	West.	2200	110/220

D.C. MOTORS

HP	MAKE	TYPE	VOLTS	SPD
300	Cr. Wh.	OCD	230	1100
200	West.	SK	230	500
220	West.	SK	230	175
150	G.E.	DLC	230	900
60	West.	SK185	230	435
50	West.	SK113	230	1750
50	Rel.	T185	230	1700
30	West.	SK93	230	1750
25	Rel.	T310	230	400/1800
20	Rel.	T282	230	400/1600
20	West.	SK83	500	1750
15/15	West.	K5	230	850/550
15	West.	SK113	230	825
10	West.	SK100L	230	400/1800
10	West.	SK80	230	750/1400
10	West.	SK60L	230	1150
9½/7½	West.	K3	230	900/585
5	West.	SK70	230	400/1600

AIR COMPRESSORS—HOISTS

142 CFM Ing. Rd. 100# pressure, belted 30 HP
356 CFM Chic. Pneu. 12"x10" 100# Pressure.
½ Ton—AC American
1 Ton (3)—DC Shepard
3 Ton—AC with motor trolley
4 Ton—DC Brown

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Charles Weaver

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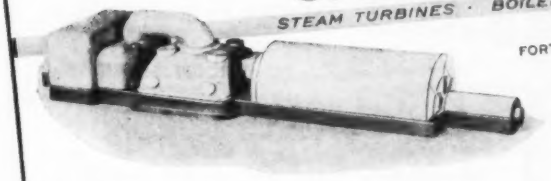

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We invite your inquiries for good Turbo-Generators in sizes from 500-KW. to 15000 KW., steam pressures from 150 to 450-psig., condensing or non-condensing.
Write for FREE Stock Bulletin Today.
Investigation and correspondence invited.
Immediate Deliveries.

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C h a r l e s W e a v e r

Also a Large Stock of Boilers, various sizes.

MOTORS • GENERATORS • TRANSFORMERS

7 x 7 AIR COMPRESSOR

Ingersoll Rand 7x7 Class ERI—100#—with or without drive.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 H.P. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP 3/60/440/1800 Gen. Elect. Motor.

600 HP GEAR REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL. Size 30/16 Speed 730 RPM to 115 RPM.

400 HP GEAR REDUCER

1—400 HP Nuttall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Westinghouse Slipring 3 Bearing 3/60/220/440/435 RPM.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP Gen. Electric Type KT 3/60/2300/1200 RPM.

150 HP Gen. Electric Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/720 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

200 HP Gen. Electric Slipring Type I form M 3/60/440/600 RPM.

200 HP Gen. Electric Type KT 3/60/440/600 RPM.

250 HP Gen. Electric Type KT 3/60/440/720 RPM.

350 KW GENERATORS

2—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

T.E.F.C. MOTORS

60 HP Westinghouse CS-607 3/60/440/900 X-Proof

50 HP Ideal New. 3/60/220/440/1800

2—20 HP Louis Allis ES. 365 3/60/220/440/1800 X-Proof

15 HP Louis Allis EX-364 360/220/440/1800 X-Proof.

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole

1—1600 AMP. Condit. 2 Pole

1—1600 AMP. Westinghouse 2 Pole

1—3000 AMP. Westinghouse 2 Pole

125 VOLT DC MOTORS

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

1—150 HP Crocker Wheel 125 Volt DC 850 RPM Ball Bearing.

Will make 1200 RPM 125 Volt Generators.

REBUILT TRANSFORMERS

3—100 KVA G.E. 1 ph., 60 cy. 2400/4160 pri. 120/240 sec.

3—1667 KVA Wagner 1 ph., 25 cy., 23,000 pri., 575 sec.

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We carry a large stock of transformers, and invite your inquiries. New Transformers built to your specifications.

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We rewind, repair and redesign all makes and sizes.

One Year Guarantee.

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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

SINCE 1912 CINCINNATI 27, OHIO

MOTOR GENERATORS

1—500 KW G. E. Syn. 250 V. 900 RPM
1—400 KW G. E. Syn. 600 V. 720 RPM
2—300 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW G. E. Syn. 250 V. 1200 RPM
1—300 KW RIDGWAY Syn. 250 V. 1200 RPM
1—240 KW G. E. Syn. 250 V. 1200 RPM
1—225 KW G. E. Syn. 125 V. 1200 RPM
1—200 KW G. E. Syn. 250 V. 1200 RPM
1—200 KW RIDGWAY Syn. 250 V. 900 RPM
1—150 KW G. E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM
1—100 KW RIDGWAY Syn. 250 V. 1200 RPM

ROTARY CONVERTERS

2—500 KW G. E. Syn. 25 0V. 1200 RPM
1—500 KW WEST. Syn. 250 V. 1200 RPM
1—300 KW G. E. Syn. 250 V. 1200 RPM
1—300 KW WEST. Syn. 250 V. 1200 RPM
2—300 KW AL-CH. Syn. 250 V. 1200 RPM
1—200 KW G. E. Syn. 250 V. 1200 RPM
1—150 KW G. E. Syn. 250 V. 1200 RPM
1—150 KW WEST. Syn. 250 V. 1200 RPM

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Used Equipment—Good Condition

Inspection Invited

EVAPORATING & CRYSTALLIZING PLANT—7 Swenson Calandria type Evaporators and one Vacuum Crystallizer, two stage. Complete plant with pumps, etc., on steel structure.

POWER PLANT—3—500 HP B & W Sterling type Boilers, complete aux. equip. Also 2 Waste Heat Boilers, same type. 1250 KVA 440 V. Generator direct connected G.E. Steam Turbine, switch board and aux. equip. Also steam driven C.P. Air Compressor size 12" x 14" x 11".

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1—2000 GPM 350' Pump with 240 HP Turbines
1—750 GPM 231' Pump with 75 HP 3 ph. motor
2—675 GPM 428' Pumps with 125 HP Turbines
2—600 GPM 380' Pumps with 72 HP Turbines
1—286 GPM 336' Pump with 50 HP 3 ph. motor
1—200 GPM 536' Pump with 50 HP Turbine
1—1100 GPM 220' Al.-Cn. Cent. Pump
4—2000-5000 GPM 32'-65', 10" & 12" Pumps
1—1000 GPM 280' all-bronze Cent. Pump
1—Kinney unused 6" Rotary Pumps
3—Blackmer 6" Rotary Pumps 500 GPM
3—750 & 1000 GPM Knowles Steam Fire Pumps
1—8" x 10" & 1—7" x 10" Triplex Pumps
1—3" x 8" Galland Hydraulic Triplex Pump
1—6" x 10" Gardner Duplex Pump 300 GPM
1—12" x 14" Duplex Air Compressor 650 CFM
1—12" x 10" I-R Air Compressor 355 CFM
2—12" x 9" Worth. Comp. 375 CFM, Vac. & Press.
1—4-stage Norwalk Compressor 28 CFM 5000 PSI
1—Sturt. 60 H.P. Turbo-Blower 7000 CFM 20 oz.
1—GE 2-stage Turbo Blower 3000 CFM 16 PSI
1—Spencer 30 H.P. Tur. Blower 4000 CFM 16 oz.
1—60 H.P. DC 230 v. 1150 RPM comp. C-W Motor
1—50 H.P. DC 230 v. 1750 RPM ball.-bear. Motor
10—Nash Vacuum Pumps and Vac.-Heating Units
250—Rebuilt Motors 1—200 H.P.
72—Exhaust Blowers, Fans, Unit Heaters
2—Kinney High-Vacuum Pumps, 110 C.F.M.
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10 to 1000 H.P.

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Steam, Gas and Electric Power Equipment

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150x850x35'—40x450x24' Steel Bldgs.
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432 HP 250# 1943 Sec. Head. WT Boiler
426 CFM Compressor w.75 HP AC Motor
150 & 60 HP Erie Economic Boilers
160 & 190 HP BRAND NEW Boilers

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The BOSTON METALS Co. *offers* BOILERS, MILL MOTORS & TURBO-GENERATORS *at Bargain Prices*

2 MODERN PACKAGE TURBO-GENERATOR SETS

with self contained condensers

1350 K.V.A.—BUILT 1943

TURBINES: Westinghouse, Serial No. 2-A-9593-99 & 2A-9593-100. Impulse reaction type—7 stages condensing—3500 H.P.—4800 R.P.M. Steam pressure 440 P.S.I.—Exhaust pressure 27½" vacuum. Temp. 740°—weight 13000 lbs.

GENERATORS: Westinghouse, Serial No. 109S20P900 & 108S20P900—3 phase two pole type—2550 K.V.A.—82½ cycles—2210 volts—100% P.F.

THESE GENERATORS CAN BE RE-WOUND FOR APPROX. 1350 K.V.A.—3 PHASE—60 CYCLE 2300 OR 440 VOLT OPERATION WITH TURBINE SPEED REDUCED TO 3600 R.P.M.

CONDENSERS: Westinghouse—2 pass—2200 Sq. ft.—vacuum 27½"—¾" tubes 12 ft. long—weight, 26,700 lbs. Condensers mounted below turbine. Oil Pump & oil cooler mounted directly on unit. Unit completely mounted on pre-fab sub-base.

THESE UNITS CAN BE DELIVERED RE-WOUND IN A VERY SHORT TIME.

6 B&W BOILERS

cross drum sectional header

BUILT 1943 — IMMEDIATE DELIVERY

Heating Surface	11417 sq. Ft.
Design Pressure	200 P.S.I.G.
Working Pressure	200 P.S.I.G.
Capacity	75,000 lbs./hour
Steam Temperature	Saturated
Furnace Volume	1024 Sq. Ft.
Feed Temperature	200°
Oil Burners	8 per boiler

BOILER DIMENSIONS
19' 4" wide, 16' 4½" high, 15' deep

BOILER TUBES
1667—1¼" straight, 12' 2" long
825—1¼" bent; 122—2" straight
(first 2 rows above fire box)
Downcomer & Uptake Tubes
4" & 4½" bent

WATER WALL SIDES IN FURNACE

HYDROSTATICALLY TESTED NOV. 1951 BY PRUDENTIAL LIFE INSURANCE CO.

3 MODERN TURBO-GENERATOR SETS

250 K.W.
440/3/60
1200 R.P.M.

TURBINES: Worthington-Moore, 440 lbs. W.P., 740° T.T., Serial No. 7454—7452—7432, type S4—5 stage condensing—28.5" Vac.—turbine speed 6097—gear speed 1200. Westinghouse-Moore reduct. gear 6097/1200.

GENERATORS: Westinghouse, 312 K.V.A.—250 K.W.—3/60/440 1200 r.p.m.—400 amps.—80% P.F.—125 volts d.c. excitation—exciters direct connected 5.5 K.W.

UNIT IS MOUNTED ON PRE-FAB SUB-BASE. BUILT-IN OIL COOLERS. THESE ARE MODERN UNITS RECENTLY REMOVED FROM A NAVAL VESSEL.

16 MILL MOTORS—*Complete With All Controls*

50 H.P. — 230 VOLTS D.C. — 600 R.P.M.

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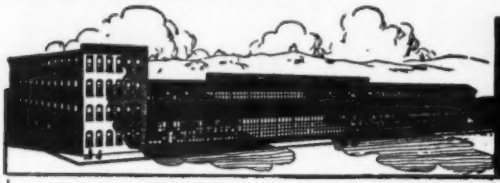
313 E. Baltimore Street — Baltimore 2, Md.

Phone Curtis 5050

All items can be seen at the Boston Metals Co. Marine Warehouse, Curtis Bay, Baltimore



GLOW ELECTRIC CO.

927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

MEMBERS OF AMERICAN REBUILDERS ASSOCIATION, A MEMBER BODY OF AMERICAN STANDARDS ASSOCIATION

SQUIRREL CAGE, OPEN 3 PHASE MOTORS

HP	RPM	VOLTS	DESCRIPTION
750	600	6000	Westinghouse
350	3600	2200	Westinghouse
300	900	440	G.E.
200	490	2200	G.E.-I
125	3600	220/440	A-C
125	1800	2200	A-C
115	1200	440	G.E.
100	1800	2200	Westinghouse
100*	1200	2200	G.E.-KF544
100	1200	440	West.-CS
100	720	440	Westgh. 3 Brg.
85	3600	2300	G.E.
60	3600	2200	G.E.
60	1800	2200	G.E.
60	1200	440	Westgh. CS
50	1800	220	Triumph
50	720	2200	Westinghouse
40	900	440	G.E.
40	720	440	G.E.
33	3600	220	G.E.-KT
35	600	440	G.E.
30	720	220	G.E.
30	514	440	Stanley
25	3600	220/440	L-A
25	1800	220	L-A-HD
25	1200	220	Century
25	900	440	G.E.
25	720	220	Westinghouse
25	600	440	G.E.
20	3600	440	A-C
20	1800	220/440	G.E.
20	1800	220/440	G.E.
20*	1800	220/440	Wesche
20	900	440	A-C
20	600	220	G.E.
15	3600	220	G.E.
15	1800	220/440	G.E.
15	1200	220	Imperial
15	900	220	Howell
15	720	220/440	A-C
10	3600	220	K. & M.
10	1800	220	Westinghouse
10	1200	220	A-C

* New Motors

MULTI-SPEED MOTORS 3 PHASE, 60 CYCLE

HP	RPM	VOLTS	DESCRIPTION
50/12½	900/450	2200	G.E., KT-356
40/20	1200/600	440	Westgh., CS-445
25/12½	1800/900	220	R&M, L-640
20	1800/1200/ 900/600	440	Century, SCN-504Y
20/10	1800/900	220	Century, SCN-27
15/10*	1800/1200	440	Westgh., CS-365
15	1800/900	220	R&M
15/7½*	1800/900	220	Wagner, 364
15	900/450	440	Reliance, B-405 high torque, high slip

SLIP RING MOTORS

HP	RPM	VOLTS	DESCRIPTION
400	514	440	West.-CW
375	1800	2300	Al. Ch.
350*	514	440	G.E., TE, FC, BB
300	1200	440	Westgh.-CW
300	720	2200	Al. Ch.
300	514	440	Al. Ch. 3 Brg.
250	600	2200	G.E.-I-17B
250	450	2200	C.-W.
250	450	2200	G.E.-I-17B
250	300	2200	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	West.-CW
200	600	440	G.E.-IM
200	514	440	West.-CW
150	1800	440	G.E.-MT
150	720	2200	Al. Ch.
120	900	550	Ideal
100	720	440	Al. Ch.
100	400	440	West. Elec. (GE)

* New

MOTOR GENERATOR SETS

D.C. OUTPUT KW	Voltage	Description	A.C. INPUT HP	RPM	Volts
1500	600	G.E., MCF	2100	720	13200
800	500	West., 3 unit	1200	1200	2300
750	550	G.E.	1070	900	2300
750	500	Westgh.	1070	900	13200
600	250	Westgh. (2-300KW Gen.)	1200	1200	2300
600	250	G.E.	800	900	2300
400	250	Westgh.-G.E.	600	1200	220/440
300	250	G.E.	450	1200	2300
200	125	G.E.-Westgh.	300	720	2300
200	125	G.E. (25 cy.)	300	720	440
200	250	G.E.-Westgh.	300	1200	440
100	250	Westgh.	147	1200	4300
75	125	G.E.	115	1200	440
50	125	C-W	85	1800	440
47½	125	Al. Ch.	100	1200	2300
40	250	Westgh.-G.E.	60	1200	220/440
22	125	Al. Ch.	23½	900	220
20	115	G.E.-Al. Ch.	30	900	220
15	250	Al. Ch.-L.A.	25	1800	220/440
12½	230	Westgh.	19½	1800	220
10	250	Westgh.	15	1800	220/440

PLATING AND ANODIZING SETS

D.C. OUTPUT AMPS	VOLTS	RPM	DESCR.	HP	A.C. END VOLTS	DESCR.
7500/3750	6/12	270	Running	60	440	West. CS Sq. Cage
4000	2 to 8	425	Jantz & Leist			
2400	40-80	1200	Westgh.	200	440	WH Sync.
1500	3 to 40	800	HVW	100	440	HVW Syn.
1500/750	6/12	1200	Running Loeb	75	440	GE— 1 Cage
1000	60	1200	Century	100	440	Century Cage
1000	20	1200	Star, 1 Brg.	—	—	—
1000	6	1200	Wagner	—	—	—
680	11	900	Westgh.	15	440	W.H. BB.
600	30	900	E-M	40	440	A-C
600	30	1200	W-E	30	440	GE
600	30	900	G.E.	25	440	GE
500	40	1200	G.E.	30	440	GE-KT
500	12	1200	Ideal	10	220	GE-KT
500	6	GE	Rectifier	—	440	—
416	12	1200	HVW	7½	440	GE-KT
400	40	1800	Hobart	25	220/440	Hobart
208	62	1800	G.E.	20	220/440	GE-KT

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

2—4000 KW, 2300 V., 150 #Cond.
1—3300 KW, 4000 V., 150# Cond.
1—4000 KW 2300 V., 400# Cond.
1—3000 KW 13,200 V., 425# Extr. 170# Non-Cond.
1—2500 KW, 480 V., 150# Cond.
1—2500 KW, 550 V., 250# Cond.
1—1500 KW, 2300 V., 200# Cond.
1—1250 KW, 2300 V., 250# Extr.
1—1000 KW, 2300 V., 175# Extr.
1—1000 KW, 4160 V., N.C. 1949
1— 500 KW, 4160 200# N.C.
2—1000 KW, 480 V., 180# Cond.
1— 750 KW Consisting of 1—500 KW, 550 V., AC 1—250 KW, 250 V., DC Non-Cond. 150#

DIESEL GENERATORS

1—1000 KVA, 2400 V.
1— 700 KW, 480 V.
3— 540 KW, 480 V.
1— 437 KW, 480 V.
1— 200 KW, 480 V.

FIRE PUMP

1—New 1000 G.P. Turbine Driven

BOILERS

3—50,000# pr hr. 275# (1949)
1— 850 H.P. 250#
1— 450 H.P. 225# 1942
1— 400 H.P. 200# 1941
2— 250 H.P. 200# 1940

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

1—125 KW 400 RPM 187½ HP Buckeye Diesel Generator Set with all accessories.
1—225 HP Buckeye Diesel 400 RPM Belted Unit

ROBERT L. NEISWANDER
LIMA, OHIO PHONES 42867, 65817

ELECTRICAL CABLE

- For every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2668 N. Clybourn Ave., Chicago 14, Ill.

SLIP RING MOTORS

3 phase, 60 cycle

HP	Make	Speed	Type	Voltage
4-3500	GE	120	TM	2300/4000
200	Whse.	600	CW	220/440
200	GE	600	TM	220/440
75	A.-C.	700	ANY	220
150	Whse.	1200	HP	2200/4000
75	GE	900	MT	440
75	GE	700	TM	220
70	English Elec.	1200	Drip proof	440
50	A.-C.	1800	ARY	440
2-40	GE	1200	TM	220

SQUIRREL CAGE MOTORS

3 phase, 60 cycle

150	GE	600	IK	2200
100	Wagner	1200	TEFC	220/440
75	Whse.	600	CCL	220
75	E-M	500	IC	440
60	Howell	1200	TEFC	220/440
60	GE	690	IK	440
50	GE	1800	K	220/440

HP	Make	Speed	Type	Voltage
40	A.-C.	1200	ARZZ-XP	220/440
30	L-A	900	JEX	220/440
30	Whse.	1200	CS-XP	440
2-20	F-M	1800	QL58C	220/440

SYNCHRONOUS MOTOR

115	E-M	600	open	220

VARIABLE SPEED MOTORS

1-3	GE	1000/600	ETA	2/60/220

VERTICAL GEAR HEAD

17-3	GE	346	TEFC	220/440

STEAM TURBINE

1—350 HP, 5000 RPM Westinghouse turbine with reducer, type C-25, output speed 1000 RPM, 150# steam, 20# exhaust.

WM. KECK'S SONS

Electric Motor & Engineering Service

201 N. Bluff Street **Joliet, Illinois**

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SINCE 1902
COMPRESSORS
VACUUM PUMPS
TRY THE BEST
YOUR CHOICE:
American—Bury—Chicago—
Curtis—Davey—Gardner
Ingersoll—LeRoi—
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American Rebuilts
Are Best

AMERICAN AIR COMPRESSOR CORP.
Dell Ave., & 47th North Bergen, N. J.

LIQUIDATION SALE

AT 270 23RD STREET, BROOKLYN, NEW YORK SOUTH 8-4902

DIESEL ENGINES

	HP	MAKE	MODEL	RPM	CYCLE
3—	1600	General Motors	16-258S (marine)	900	4
1—	500	GMC Winton	204-8 (marine)	1000	4
1—	285	Chicago Pneumatic	RH-75-D	300	4
2—	200	GMC Winton	6-138 (marine)	700	4
8—	150	Superior	SMRA-4 (marine)	2400	4
2—	150	GMC Winton	6-179 (marine)	800	4
5—	69	Hercules	DJXC	2600	4

Also: Fairbanks-Morse, AEC and Junkers

AC MOTORS—3 PHASE, 60 CYCLE

	HP	V	RPM	MAKE
1—	150	440	690	Westinghouse (slip ring)
1—600 HP at 93⅓ Cycle 400 RPM or 3800 HP at 60 Cycle 257 RPM.				GE
1—	75	220/440	690	Westinghouse (slip ring)
1—	75	440	565	General Electric (slip ring)
1—	60	220	870	Westinghouse (slip ring)
1—	40	220	1200	General Electric
15—	2¾	440	3500	Electro Dynamic
65—	½	220	1725 (2 phase)	Western Electric

32—GMC 6-71 Twin Diesels

D.C. DIESEL GENERATOR SETS

1—	60 KW	Superior model	GA-8
2—	80 KW	Cummings	HGD
1—	60 KW	Buda	6DCG
1—	60 KW	Cummings	HGD
2—	20	Hill	4R
1—	20	Hill	
2—	15	Hercules	DOOD
1—	11	Petters	
6—	10	Hill	2-R
1—	4	Junkers	1HK65

A.C. DIESEL GENERATOR SETS

1—	KVA	Chicago Pneumatic	4-H40-S
1—	75 KW	Cooper-Bessemer	GAWD
1—	40 KW	Buda-Lanova	6LD
1—	37½	Fairbanks-Morse	V
1—	31.3	Chrysler	IND-3
1—	32.5	Fairbanks-Morse	32

MOTORS—DC

1500 HP—525V-600 RPM, Westinghouse
222 HP—230V-3050 RPM, Westinghouse

GENERATORS—DC AND AC

From 1 to 1500 KW

MOTOR-GENERATOR SETS, DC, 230 V to 3/60/120

3—25 KVA, Continental
3—25 KVA, Burke Electric Company

GASOLINE ENGINE-GENERATOR SETS

1—34 KW Buffalo Gasoline engine, type R, 900 RPM, with Western Electric 5-G-101 generator, 230 volts.
Also large number from ¾ KW to 5 KW.

GASOLINE ENGINES

2—Sterling "Admiral" (marine), 800 HP @ 2200 RPM
8—Hall Scott "Defender" (marine), 680 HP @ 2100 RPM
8—Wright-Hispano Suiza, 360 HP @ 1750 RPM
6—Waukesha, 42 HP @ 2200 RPM
Also large number from 1 HP to 25 HP

NEW STEAM TURBINES

20—General Electric, 1000 HP, 525± temp. 825° F, with Falk reduction gear, pinion RPM 5405, gear RPM 3060, complete with throttle valves and other parts.
10—58.5 HP, 300-475 lbs. Steam—10-15 lbs. Exh. Pressure. 1225-1600 RPM, Sturtevant.

NEW DIESEL ENGINES PARTS

98—Fuel oil filter assemblies for General Motors 6-71 twins
9—Kits, spare parts for Buda 6-DTG-468 diesel large stock
Alco Model 540
Alco-Lube Oil Cooler, size 1054
GM-Harrison Rad. Div. Model No. H.E. 2120-327

AIR COMPRESSORS—DIESEL DRIVEN GASOLINE DRIVEN, ELECTRIC DRIVEN

From 64 CFM to 500 CFM, Ingersoll Rand, Schramm, Gardner-Denver, Sullivan, Chicago Pneumatic, etc.

CENTRIFUGAL PUMPS

From 1000 GPM to 6000 GPM, 100/300 feet.
Also motor driven pumps

LUBRICATING PUMPS

2—Burke Electric Company, horizontal, 55 HP, 115 V. DC.

BLOWERS

12—Ilg Company centrifugal electric-driven ventilating blowers, from 5,460 CFM to 23,250 CFM capacity, with 3/60/440 motors
3—Buffalo Forge Company hull ventilating blowers, 8000 CFM with GE motor, 6 HP @ 1735 RPM

AXIAL FLOW FANS—NEW

16000 CFM—3" S.P. 3/60/440, Sturtevant
8000 CFM—3" S.P. 3/60/440, Buffalo
6000 CFM—3" S.P. 3/60/440, American
35000 CFM—1" S.P. 230V, DC, Wing

MARINE REDUCTION GEARS

9—Twin disc assembly, duplex, manufactured by Link Belt Engr. Co., 950 HP @ 2400 RPM, input shafts, output speed 596.4 RPM.

FREQUENCY CHANGER

1—20 KW frequency changer, General Electric KT-512Y motor, 25 HP, 3/60/220, output motor 3/180/220.

WELDING MACHINES

8—300 amp. gasoline driven
1—1000 amps., diesel driven
Motor driven welders, transformer type. Spot-welder

HICYCLE TOOLS—3/180/220

(Motor generator set available)

700—drills, nut runners, screwdrivers, impact wrenches

ICE PLANTS

7—One-ton portable York ice plants, model Y-50, with Continental 4-cylinder gasoline engine
1—Fifteen-ton York ammonia compressor

HOISTS AND WINCHES
CRANES
TRACTORS
WAGON DRILLS
CONCRETE MIXERS

POWER HOUSE EQUIPMENT

2—6000 KVA, 3ϕ, 60 cycle, 13/200/2940 V, Westinghouse transformers
6—2000 KVA, 1ϕ, 60 cycles, 13/200/2870 V, Westinghouse transformers
4—50 KVA, 1ϕ, 60 cycle, 2750/220/110 V, Westinghouse transformers
6—50 KVA, 1ϕ, 60 cycle, 2750/110 V, Westinghouse transformers
3—550 KVA, 1ϕ, 60 cycle, 3500/3500 V, Westinghouse transformers (Bus tie)
12—150 KVA, 300 A, 13,200 V, Metropolitan Division Corp. reactors
18—60 KVA, 1ϕ, 3,000 V, General Electric regulators
26—60 KVA, 1ϕ, 3,000 V, Westinghouse regulators

86—Westinghouse type B-13, 600 to 1,600 amps, 3,000 to 15,000 V truck switches

2—Westinghouse type F-10, 200 amps, 2,500 V, 3 PST, oil circuit breakers
1—26 Panel vertical type control board
1—22 Panel relay board
1—2 Panel LT AC board
4—Buffalo Forge Company blowers (without motors)
2—BF Sturtevant Company blowers (without motors)
1—Traveling Crane with 1—six-ton, and 1—two-ton trolley hoist
1—Traveling crane with 1—three-ton trolley hoist

20,000 LIGHT BULBS
1000 Watts 220-250 Volts

2—Concrete Brickmaking Machines, Brickmaster Model 10

Air Coolers
Condensers, from 155 to 8000 sq. ft.
Air ejectors
Blowers — air pumps
Push button starters, 7½ HP
Vapor compressors
High pressure air compressors
Centrifuges
Evaporators
Soot blowers
Pumps—motor & turbine driven
Oxygen producing plant
Welding electrodes
Reduction gears
Motors — AC & DC
Generators
Machine Tools
Diesel parts
Radiator core soldering furnace
Vertical Plate Bending roll, capacity 1¼"x14"
Niles heavy duty plate shear—16" knife, 36" gap
Niles Bement plate planer, 20", 2 cutting heads
Milling machines
Forging hammers
Underwater velocity tools
Gasoline locomotives
Road Rollers — 6 ton
Heat exchangers
DC Turbo-generators
Transformers
Light plant
Fork & Platform lift trucks
Degreasing machines
Flexible shaft grinders
Riveters
Sanding Discs
Hydraulic Jacks
Viscolizer pump
Pulverizers
Dessicite
2" Marine rubber bearings
6" Suction and refueling hose
Feed rolls, 1000 amps., 3 conductor
Wire rope
Wire rope slings

EASTERN SCRAP & SALVAGE CORPORATION

65 MUIRHEID AVENUE, TRENTON 7, NEW JERSEY **TELEPHONE 5-6349**

TURBO-GENERATORS

AVAILABLE IMMEDIATELY

1—6250 kva 5000 kw 3600 rpm Allis-Chalmers 200 lbs. 100° SH condensing. Will operate 275 lbs. 615° TT without change. Generator 3/60/11500 can be changed to 2400/4160 V. Complete auxiliaries—can be operated for inspection. Checked by factory engineer in September 1951—no repairs required.

1—1875 kva 1500 kw 3600 rpm General Electric 150 lbs. 0° SH condensing. Generator 3/60/2300.

1—1567 kva 1250 kw 3600 rpm Allis-Chalmers 150 lbs. condensing. Will operate 200 lbs. 450° TT without change. Generator 3/60/2300. Complete auxiliaries.

1—1250 kva 1000 kw 3600 rpm Westinghouse 185 lbs. 100° SH condensing. 3/60/2300. Completely reworked, generator has new winding. Complete auxiliaries.

1—937 kva 750 kw 3600 rpm General Electric 150 lbs. condensing. Generator 3/60/2300.

1—625 kva 500 kw DeLaval geared 5000/900 rpm 150 lbs. condensing. Generator 3/60/2300. Can operate 275 kw 10 lbs. BP without change.

1—1871/2 kva 150 kw Westinghouse geared 7200/900 rpm 150 lbs. 100 SH non-condensing. Generator 3/60/240.

1—125 kva 100 kw West. geared 7200/900 rpm 150 lbs. non-cond 3/60/240.

1—500 kw 3600 rpm GE non-condensing 175 lbs. throttle 30 lbs. BP 3/60/2400.

ALSO IN OUR STOCK

BATTERY CHARGER
2—400 amp 42 volts Hirtner M-G set 3/60/220-440 with complete D.C. control and motor starter.

COMPENSATORS, A.C. AUTOMATIC
75 hp 3/60/2300 Cutler Hammer Bul. 9622 w/current limit, fuses. New
125 hp 3/60/2200 G.E. CR7051-H1A.

COMPENSATOR, A.C. MANUAL
100 hp 3/60/2200 Westinghouse Type A

CONDENSERS
2—725 sq. ft. C. H. Wheeler 2 pass surface. New

COMPRESSORS, AIR
1000 CFM @ 225 rpm CP 2 stage 20"x12"x14" short center belt drive.

DIESEL GENERATORS
250 kw 400 rpm 3/60/220-440-2200 Superior VLO

ENGINE GENERATORS
2—85 kva 327 rpm 3/60/220 Engberg 8x10 vertical 175 lbs. non-condensing.

GASOLINE ENGINE GENERATORS
50 kw 1800 rpm 3/60/220 Waukesha-Bardco on wheels.

GENERATORS, A.C.
375 kva 225 rpm 3/60/220 Allis-Chalmers engine type
250 kw 1800 rpm 3/60/2200 Westinghouse ped. brgs.
200 kw 720 rpm 3/60 any voltage GE ped. brgs.

GENERATORS, D.C.
75 kw 1290 rpm 125 V. GE single brg.
20 kw 1200 rpm 125 V. GE CDM

MOTORS, SLIP RING
350 hp 360 rpm 3/60/2200 GE Type IM
200 hp 1800 rpm 3/60/2200 GE Type IE 13B
200 hp 1800 rpm 3/60/440 GE Type IM
100 hp 900 rpm 3/60/440 GE Type MTC5346
75 hp 1800 rpm 3/60/2200 Westinghouse C.W.
2— 75 hp 720 rpm 3/60/2200 Westinghouse HF
50 hp 720 rpm 3/60/2200 GE Type MT552
50 hp 900 rpm 3/60/2200 GE Type IM

MOTORS, SQUIRREL CAGE
125 hp 3600 rpm 3/60/2200 GE Type FT
60 hp 1800 rpm 3/60/220-440 F-M Type H
50 hp 720 rpm 3/60/2200 GE Type KT546

MOTORS, SYNCHRONOUS
400 hp 1800 rpm 3/60/2200 Westinghouse ped. brgs.
290 hp 720 rpm 3/60 any V. GE Type ATI ped. brgs.

MOTOR-GENERATOR SETS
1000 kw 600 V. 514 rpm Westinghouse 1440 hp any voltage syn. motor

PUMPS, BOILER FEED
750 gpm 450 lbs. 3600 rpm Goulds 3360 4"—4 stage
475 gpm 750 lbs. 3600 rpm Goulds 3360 3"—6 stage
2—150 gpm 230 lbs. 2750 rpm Frederick steam turbine

OIL CIRCUIT BREAKERS
600 amp. 110,000 V. Max. GE FK0136 outdoor
600 amp. 15000 V. West. FO221 o/d solenoid oper.
600 amps. 15000 V. Conduit OI o/d solenoid oper.
9—1200 amp 15 KV Westinghouse CO-11 De-Ion Grid 500,000 KVA 125 v. D.C. solenoid indoor
1—2000 amp 15 KV Westinghouse CO-11 De-Ion Grid 500,000 KVA 125 v. D.C. solenoid indoor
2—800 amp. 15 kv 130,000 kva West. Type B-20 indoor
1—400 amp 73 KV Gen Elec FK0238 outdoor
10—400 amp. 15 kv 130,000 kva West. Type B-20 indoor

TRANSFORMERS, 60 CYCLES
2—1000 kva self cooled (1800 kva water cooled) 3 ph. 60 cy. GE 6600 to 440 V.
2—1000 kva 13800/2300 V. 1 Ph. GE Type H Form VDDJ
3—75 kva 2400-4160/240-480 V. 1 Ph. GE Type H Form KF
3—37½ kva 2400-4160/120-240 V. 1 Ph. GE Type H Form K
121—10 kva 2400-4160/120-240 V. 1 Ph. Various Makes—All modern
20—7½ kva 2400-4160/120-240 V. 1 Ph. Various Makes—All modern
35—5 kva 2400-4160/120-240 V. 1 Ph. Various makes—all modern

TAMPA ARMATURE WORKS INC.

401 S. MORGAN ST. PHONE 2-1966 TAMPA, FLORIDA

FOR SALE

We have in stock for immediate delivery the following items of silent chain belting, all in excellent condition, reasonably priced:

Pcs.	Pitch	Width	No. Links	Mfg'd by
1	1½"	12"	76	Link-Belt Co.
1	1½"	12"	233	" "
1	1½"	10"	116	" "
1	1½"	10"	21	" "
1	1½"	10"	117	" "
1	1½"	12"	178	" "
1	1½"	8"	64	" "
1	1½"	6"	62	" "
1	1½"	6"	145	" "
1	1½"	8"	118	" "
1	1"	8"	90	" "
1	¾"	3"	122	" "
1	¾"	6"	104	" "
1	1¼"	6"	58	Morse Chain Co.

For further details concerning price F.O.B. Springfield, Mass., inspection, etc., contact:

FS-4777, POWER
330 W. 42 ST., NEW YORK 36, N. Y.

PRICED TO SELL

USED MINING MACHINERY ELECTRICAL EQUIPMENT

2—150 H.P.—H.R.T. 150 P.S.I. boilers
1—125 H.P.—H.R.T. 150 P.S.I. boiler
1—150 H.P.—125 lb. P.S.I. Scotch marine boiler
Electric mine hoist G.E. motor 52 H.P. 1600 Ft. 7/8 cable
2—General Electric A.C. generators type A.T.B.—36-250-200, 3 phase 250 KVA form E.K.W. 250 PF-1, 2300 volts, 628 amps., speed 200.
Large assortment of electric motors from 3 H.P. up to 50 H.P. Transformers from 3 KVA to 75 KVA

ALBUQUERQUE IRON & METAL CO.
1012 N. 1st St., Albuquerque, New Mexico

COMPRESSORS AIR or GAS

GUARANTEED REBUILT

All Types and Sizes

Motor and Steam Drive

Also:—Aftercoolers, Air Receivers, V-Belt Drives.

EARL E. KNOX CO.
1107 BACON ST. ERIE, PENNA.

REFRIGERATION UNITS

TWO PRACTICALLY NEW WORTHINGTON CARBONDALE

REFRIGERATION COMPRESSORS

300 Ton Freon

Ideal for large plant or office building

WILL SACRIFICE

WINSTON MACHINERY CO., INC.
326 WEST OHIO STREET
INDIANAPOLIS, INDIANA

DIESEL, NAT. GAS OR GASOLINE ENGINES

15—400 HP General Motors 8 cyl. 8x10, 900 RPM equipped for nat gas, butane or gasoline, weight only 12,000 lbs.
2—360 HP, 1—240 HP F&M Mod 32 w/ generators
2—180 HP, F&M, 3SE, 8½x10, 475 RPM
2—120 HP Atlas, 6 cylinder, 550 RPM
1—200 HP Buda Diesel Power Unit, 900 RPM
1—100 HP, A-100 International, 1800 RPM
All above reconditioned & offered at bargain prices, or will rent. We offer other engines, generators; electric motors; pumps; compressors; switchgear & electrical apparatus. 5000 stock items, each a bargain.

GENERAL MACHINERY & EQUIPMENT CO., INC.
809 Woodland Kansas City 6, Mo.
Telephones Victor 0018 & 19

SPECIAL TRANSFORMERS — YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGES

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

RUBBER MILLS

2—Farrel-Birmingham 18" x 42", 13½" bearings, with a 75 H.P. synch. motor.

1—Calender 6" x 12" w.c. Rolls, motor driven.

DALTON SUPPLY CO.
2829 Cedar St. Phila. 34, Pa.

There's more than 40% to 60% SAVINGS on

SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

A.G. SCHOONMAKER CO., INC.

52 CHURCH ST., NEW YORK 7, N. Y.

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT.

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1500	Fairbanks Morse	33E16	2000	300
1136	Fairbanks Morse	38D	1600	720
1000	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
500	General Motors	8-278A	750	720
500	General Motors	8-567	720	720
350	Baldwin	VO-6	510	450
320	Buckeye	80	480	600
320	Enterprise	DSG-6	460	450
250	Fairbanks Morse	33-D	375	360
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
167	Ingersoll-Rand	S	255	600
160	Buckeye	80	240	600
150	Worthington	CC-4	225	450
100	General Motors	3-268A	150	1200
100	Worthington	BB-5	150	600
60	General Motors	6-71	90	1200
30	Inter. Harvester	UD-14	45	1200
15	Inter. Harvester	UD-6	23	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED

ONE YEAR GUARANTEE!

TURBINE GENERATOR UNITS
3 Phase 60 Cycle

25000 KVA G.E. Cond. 250 lbs. 13200 volts.
21500 KVA G.E. Cond. 250 lbs. 2400 volts.
18750 KVA A.Ch. Cond. 200/400 lbs. 13200 volts.
6250 KVA A.Ch. Cond. 200 lbs. 4160 volts.
5000 KVA G.E. Non-cond. Extr. 600 lbs.—125 lbs. Extr. 50 lbs. Exh. 13800 volts.
5000 KVA West. Cond. Extr. 400 lbs.—50 lbs. Extr. 600 volts.
5000 KVA G.E. Cond. 400 lbs. 2300/4000 volts.
2500 KVA West. Cond. 250/400 lbs. 2400 volts.
1563 KVA G.E. Cond. Extr. 200/400 lbs—5/25 lbs. Extr. 2400 volts.
1250 KVA West. Cond. 450 lbs. 2400/4160 volts.
750 KVA Murray Non-cond. 250 lbs.—30 lbs. Exh. 240 volts.
625 KVA G.E. Non-cond. 150/400 lbs.—50 lbs. Exh. 2300 volts.

ENGINE GENERATOR UNITS
3 Phase 60 Cycle

770 KVA Skinner Uniflow, 150 lbs. 2300 volts.
750 KVA Ames Vert. Uniflow, 150 lbs. 4160 volts.
625 KVA Skinner Vert. Uniflow 150 lbs. 480/240 volts.
312 KVA Skinner Uniflow, 150 lbs. 480/240 volts.

DIESEL GENERATOR UNITS
3 Phase 60 Cycle

1000 KVA DeLaVergne, 2400 volts, 200 rpm.
875 KVA DeLaVergne, 2400/4160 volts, 327 rpm.
700 KVA Fairbanks-Morse, 2400 volts, 300 rpm.
600 KVA Fairbanks-Morse, 2400 volts, 300 rpm.
475 KVA Cooper-Bessemer, 2400 volts, 400 rpm.
300 KVA Worthington, 208-120 volts, 450 rpm.

GENERATORS
3 Phase 60/240 Cycle

7500 KVA G.E. 60 cy. 13800 volts, 720 rpm.
4600 KVA G.E. 90 cy. 2400 volts, 5400 rpm.
2859 KVA (3) G.E. 180/240 cy. 2300/4150 volts, 3600/4800 rpm.
2500 KVA G.E. 60 cy. 2400/480 volts, 3600 rpm.

STEAM BOILERS

100,000 lbs. per hr. Badenhausen, 170/700 lbs. pulv. coal.
50,000 lbs. per hr. B. & W., 420 lbs., pulv. coal.
30,000 lbs. per hr. B. & W., 435 lbs., gas or oil.
20,000 lbs. per hr. B. & W., 175 lbs., stoker coal.

TRANSFORMERS
60 Cycle

1,000 KVA (3) West. 1ϕ, 6900/11950-2300 volts.
750 KVA Mol. 3ϕ, 13200-2200 volts.
667 KVA (3) Mol. 1ϕ, 19920/34500-2400 volts.
600 KVA (3) G.E. 3ϕ, 11000/22000-2300/460 volts.
500 KVA (3) Mol. 1ϕ, 44000-33000 volts.
500 KVA (3) West. 1ϕ, 13800-2300 volts.
500 KVA (4) Mol. 1ϕ, 19920/34500-2400 volts.
500 KVA (3) West. 1ϕ, 33000-2300/4000 volts.
333 KVA (3) G.E. 1ϕ, 33000-3300 volts.
150 KVA (3) West. 1ϕ, 19050/33000-2300 volts.
100 KVA (3) West. 1ϕ, 33000-240/480 volts.

SYNCHRONOUS CONDENSER

7,500 KVA G.E., 3 phase, 60 cycle, 13800/6900/4000/2300 volts, 720 rpm.

INTERNATIONAL POWER MACHINERY CO.

1609 UNION COMMERCE BLDG. Telephone: MAin 1-9514 CLEVELAND 14, OHIO

MOTORS—M. G. SETS—TRANSFORMERS

ENGINEERED AND REBUILT BY EXPERTS IN OUR OWN PLANT

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1	400	Cont.	NZ-906	2300	1200
1	400	G.E.	IK	2200	514
1	400	G.E.	KT-412	2200	435
2	300	Whse.	CS-890	2300	1780
1	200	Whse.	CS-873C	2200	1160
1	200	Al.Ch.	AR	440/220	580
2	125	Al.Ch.	AR	2200	1750
1	125	Whse.	CS-761C	440/220	1750
1	125	C.W.	126-Q	440/220	430
2	100	Whse.	CS-663C	440/220	1750
1	100	Al.Ch.	AR	550	690
1	100	F.M.	H241B	440/220	435
1	100	Whse.	CS-938	2300	495
1	75	G.E.	I-K15	440/220	570
1	75	Al.Ch.	AR	2200	1765

MOTOR GENERATOR SETS

Qu	KW	Make	RPM	Volts DC	Volts AC
1	2400(3-U)	Al.Ch.	720	525	4800/2400
1	2400(3-U)	Whse.	720	600	4800/2400
1	1000	G.E.	514	550	2300
1	1000(3-U)	Whse.	900	250/125	4160/2300
1	500	C.W.	720	250/275	2300/440
2	500	C.W.	720	575	2300/440
1	500(3-U)	Whse.	1200	230	440
1	250	Whse.	1200	125/250	2300
1	200	Whse.	1200	125/250	2300/440
1	200	Ridgway	900	275	2200
1	155	G.E.	720	250	2300/440
1	150	G.E.	1200	500	2300/440
1	100	Al.Ch.	2000	125/250	4000/2300
1	100	C.W.	1200	125	440/220
1	100	Delco	1200	125/250	440/220
1	100	Ridgway	1200	275	4000/2300
1	85	C.W.	1200	250	4000/2300
1	75	Star	1200	230	440/220
1	75	Al.Ch.	900	250	2300
1	75	Whse.	900	75	2200

We can furnish any of the above sets with exciters and VARIABLE VOLTAGE CONTROL engineered and rebuilt for your requirements.

SLIP RING MOTORS—CONSTANT DUTY
3-Ph., 60-Cy.

Qu	HP	Make	Type	Volts	RPM
1**	1800	G.E.	MT-498	2300	352
1**	1200	G.E.	MT-26	2200	275
2**	1000	Al.Ch.	ANY	2200	235
1**	600	G.E.	MT-20	2300	360
2	600	G.E.	I-16-M	2300	450
1	400	Al.Ch.	ANY	2200	514
2	400	G.E.	MT-412	2200	450
1	300	Al.Ch.	ANY	2200	514
1	250	Al.Ch.	ANY	440	720
1	250	G.E.	MT-414	2200	300
1	200	G.E.	I-16-M	2200	600
1	150	G.E.	I-13-M	2200	1750
1	125	Whse.	CW-870	2200	600
1	100	F.M.	H20C	440	900
2	100	G.E.	I-15-M	2300	514
1	75	Whse.	CW-7540	440	720
1	60	Whse.	C.W.	440	900
1	60	G.E.	MT-536	2200	1200

With the above we can supply manual or full magnetic control, standard or reversing, also with dynamic braking if required.

MOTOR GENERATOR SETS COMPLETE WITH CONTROLS STILL ON THEIR FOUNDATIONS AVAILABLE FOR IMMEDIATE SHIPMENT

(3) West., (4) G.E. 1,000 KW, 600 VDC Generators, compound, interpole, 514 RPM, 1440 HP., syn. motors, (1,000 v., 3 ph., 60 cy. (Will reconnect for 6,600 v.)

(3) G.E. 1,500 KW, 250 VDC, 514 RPM compound, interpole, pulsface windings, 2,100 HP., syn., motors, 8 pf, 13,200 v., 3 ph., 60 cy. (Will reconnect for 6,600 or 4,160 v.)

Priced right for REMOVAL

SYNCHRONOUS MOTORS
3-ph., 60-Cy.

Qu	HP	Make	PF	Volts	RPM
1	6000	G.E.	100	2300	90
1	3000	Whse.	80	4800/2400	720
2	2100	G.E.	100	2300	360
2	1750	G.E.	100	2300	3600
1	1000	El.Mchy.	100	440	1200
1	750	G.E.	80	2300	450
1	250	G.E.	80	2300	514
1	250	El.Mchy.	80	440	400
1	187	G.E.	80	220/440	720
1	150	G.E.	100	2200	900
1	150	G.E.	100	550	600
1	150	G.E.	80	550	450
3	135	G.E.	80	4000/2200	1200
3	125	El.Mchy.	100	4800/2400	900
1	125	G.E.	80	2200	900

DIRECT CURRENT MOTORS

Qu	HP	Make	Type	RPM
1***	3000	Whse.	Encl.(Rev.)	600
1***	2400	Whse.	Encl.(Rev.)	600
4***	1500	Whse.	Encl.(Rev.)	600
4***	1200	Whse.	Encl.(Rev.)	600
4***	800	Whse.	Encl.(Rev.)	600
1	350	G.E.	CD-189-A	1150
1	300	Whse.		240/300
1	200/250	El.Dy.	No. 22	400/1200
1	250	G.E.	MPC	325/975
1***	200	G.E.	MPC	500/1200
1	200	Whse.	Mill	300/1200
1	180	G.E.	MPC	400
1*	150	C.W.	83-H	890
1***	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
1	90/160	G.E.	MPC	625/1125

All above 230-VDC except where marked ***.
***—Pedestal bearing mill design 325/600-VDC.
Rev.—designed for mill reversing service.
*—T.E.F.C.

T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA

MOTORS!! PUMPS!! TRANSFORMERS!!

3—833 KVA Westinghouse transformers OISC, 1 ph., 2400/4160Y to 480 volt, Type SL, Ser. 2,150,000.
5—150 KVA Westinghouse Transformers OISC, 1 ph., 60 cy., 2300 to 460/230/115, Type SK, Ser. #528171, -2, -3.
3—50 KVA Mahoney Transformers, with taps, OISC, 1 ph., 2400—120/240, Type HE, Ser. 245405, -6, -7.
1—100 HP Allis Chalmers, Slipring, Type ARY, BB, 3/60/220/440/900, Frame 826E
3—100 HP, 1800 RPM Westinghouse Sq. Cage, type CS 6616, 3/60/220/440
3—75 HP, Westinghouse Sq cage motors 3/60/220/440/900 Frame 752C Type CS
1—125 HP, 600 RPM, EM, Synchronous 3/60/2200 type BRKT
1—200 KW MG set, 125 V. DC, 900 RPM Syn. drive, 3/60/2300 E.M. Factory Set
2—74x24 Dayton Dowd CS24, 16,500 GPM, 18.5/35 FT. HD., 360/450 RPM

BENSON-WILIMZIG, INC.
Phone GARFIELD 4200
1708 NORTH EIGHTH STREET
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ADJUSTABLE SPEED EQUIPMENT

RELIANCE V*S DRIVES
U. S. VARIDRIVES
GENERAL ELECTRIC
ACA MOTORS
SPEED VARIATORS
THYMOTROLS
MULTISPEED MOTORS
WOUND ROTOR MOTORS
ADJUSTABLE DC MOTORS

Large stock of New and Rebuilt Drum controllers, Grids, and Resistors.

For prompt engineering service and price and delivery quotations, call or wire

SANDMAN ELECTRIC CO., INC.
665 Parker Street
Boston 20 (Roxbury), Mass.

BOILERS—Package—Type WATER TUBE 3604 HS, 262± WP, with steel shells and integral furnaces. ASME. Move without dismantling. Priced to sell!

1 ea. ±590 Kewanee 2-pass firebox boiler 100±, ASME, with stoker 75% saving. 10-1000 H.P.

New & Used Boilers at a Great Saving—Advise Requirements.

UNITED STEEL PRODUCTS CO.
1534 Texas St., Memphis, Tenn.
Phone 35-2855

BOILERS FOR SALE
Two 250 HP B. & W. Water tube boilers, now in operation under Hartford Inspection at 100 pounds. All pipe, valves, and accessories included with 150 ft. steel stack. Available immediately.
POINSETT LUMBER & MANUFACTURING CO.
TRUMANN, ARKANSAS

SLIP RING MOTORS—3 Ph., 60 Cy.

1	40	**Al. Chal.	449	B. Brg.		900
1	50	West.	220	CW		1175
1	60	West.	220-440	CW	766A	870
1	500	G.E.	2300		17B	900
1	*600	West.	440	CW	432D15	1800

SYNCHRONOUS MOTORS—3 Ph., 60 Cy.
With Direct Connected Exciters

1	75	El. Mach.	220			1200
2	125	**El. Mach.	4800			900
15	135	***G.E.	4000	TS	963Z	1200
1	*200	**El. Mach.	208			1200
1	*300	**El. Mach.	208			1200
1	*350	**El. Mach.	208			1200
1	*400	**El. Mach.	440			1200

NEW G.E. AC GENERATORS W/PANELS
100—3 KW 3/60/120—208/1800 RPM
50—10 KW 3/60/120—208/1800 RPM
*NEW—**BALL BEARING—***SEP. EXCITER

ALBERT HELLER CO.
210 Snediker Ave., B'klyn 7, N. Y. HYacinth 5-0800

COMPLETE DIESEL PLANT

3—Fairbanks Morse units. 805 HP—556 KW; 690 HP—473 KW; 300 HP—200 KW. Model 33-E-14. 3/60/2400 volts. New 1940. Will sell all or part. With auxiliaries. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

BOILER FEED PUMPS

2—A.-Ch. 400 G.P.M., type ML, 6 stage, size 5 x 4, 1614 Ft. Hd.
1—Worth. 740 G.P.M., type WCS-2, 5", 2250 Ft. Hd.
1—Worth. 700 G.P.M., type UNS-1, 6 stage, 6", 1550 Ft. Hd.
2—I. R. 200 G.P.M., 2", 1375 Ft. Hd.
Pumps above are mounted on basis for motor or turbine drive.

We have about 200 various size cent. pumps on hand, turbine, motor, and gasoline driven. Send us your inq.

DALTON SUPPLY CO.
2829 Cedar St. Phila., 34, Pa.

REBUILT POWER EQUIPMENT—READY TO SHIP!

FOR SALE or RENT
SPECIAL BARGAINS
DIESEL ENGINE GENERATOR SETS

4—100 KW., 120/240 V. D.C. Delco Generators dir. con. to 150 HP., Model GBD-3, 5½ x 7, 8 cyl., Superior Diesel Engines, elec. start, power panel, accessories. Practically new—only used for spares.
1—100 KW., 220/440 V., A.C. 3 ph. 60 cy. West. Gen. dir. con. to 150 HP. Superior Diesels same as above.
1—90 kva. Fairbanks Morse 220/440 V. 3 ph. 60. cy., 360 rpm. DIESEL.
1—37½ kva. 3 ph. 60 cy. 127/220 v. or 220/440 v. 1200 rpm., Century A.C. Generators with dir. con. exciters driven by 70 HP., 4 cyl. Model UD-14 International Harvester DIESEL Engines with panels.
2—25 kva. 128 v. 1 ph. 60 cy. Westinghouse dir. con. to 58 HP., 4 cyl. 900 rpm., LeRoi Gasoline Engines with control panels.
3—25 kw., 220/440 v. 3 ph. 60 cy. Westinghouse direct connected to 4 cyl. LeRoi Gasoline valve in head liquid cooled Engine complete with control panels.
17—7½ KW., 120 V. 1 ph., 60 cy. Continental Gas Engines.
2—New 5000 Watt—115/230 V., 1c. 60 cyl. Wisconsin Gas Engines.

DC VARIABLE SPEED MOTORS
230 Volts

HP	MAKE	RPM	TYPE
400	All. Chal.	400/1200	
125	Westg.	125/500	RB Anti-Fric.
100	Westg.	500/1000	SP BB
75/150	G.E.	300/1200	CD-180 BB Enc.
75/100	Westg.	600/1200	SA-13L SB
50	G.E.	600/1200	LC
50	Reliance	400/1600	T-985P TEFC BB
50	Reliance	300/1200	T1985T BB
50	Crkr. Wblr.	1300/200	CMC-8SB
40/50	Reliance	500/1500	T-461T BB
40	Westg.	750/1500	SK-140
40	Al. Chal.	575/1150	E-145
40	Reliance	500/1500	T-461P TEFC BB
40	Reliance	400/1600	T-613P TEFC BB
40	El. Gen. Co.	385/1200	Frame 1868
35	G.E.	625/2100	COM-1829 AE
35	G.E.	350/1400	RP-162 SS
30/40	Imperial	400/1600	D-D69 BB DP
30/40	Reliance	300/1200	T-651 TE BB
30	Westg.	1150/1750	SK-133 TEFC BB
30	Reliance	400/1600	T-461F TEFC BB
30	Imperial	400/1600	D-D69 BB DP
25	Reliance	400/1600	T-310F TEFC BB

CRANE AND MILL MOTORS
230 Volt D.C.

Qu.	H.P.	Make	Type	RPM
4	30/40	West.	MC-50	525/440
2	15	West.	K-6	610
5	7½/6¾	West.	K-3	585/680

TRANSFORMERS—1 Ph. 60 Cy.

No.	KVA	MAKE	PRIM.	SECONDARY
4	15	G.E.	2200	110/220
10	25	G.E.	2200	110/220
3	25	West.	2200	110/220
1	30	G.E.	2200	110/220
9	37½	G.E.	2200	110/220
3	40	G.E.	2300	110/220
11	50	G.E.	2200	110/220
3	50	West.	2200	110/220
3	75	West.	2400	120/240
1	75	West.	13200/6600	2300
1	75	Pgh.	4600	115/230
1	100	Pgh.	2300/4600	115/230
6	100	Pgh.	4600	115/230
1	100	West.	2300	230/460
2	150	Pgh.	4600	115/230
1	150	G.E. (3 Ph)	2200	240/480
3	300	All. Chal.	22000	2300
3	200	Pgh.	25000	460
2	250	G.E.	2400	480

IMMEDIATE DELIVERY
AIR COMPRESSOR
876 cfm Chicago Pneumatic 100 lb. pressure 2300 or 440 v. A.C. syn. motor complete with starting equipment.

AC MOTORS
220/440 Volt—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
525	Elliott	720	Syn.
450	Elliott	720	Syn.
350	West.	585	CS
300	G.E.	1800	KT-563
250	G.E.	515	KP-TEFC
250	Burke	720	Syn.
250	G.E.	1150	IE-15
225	Elec. Machy.	1800	Syn.
200	West.	291	CS
200	G.E.	430	KP-TEFC
200	G.E.	900	IE-15
200 NEW	G.E.	1150	KG Hi Torque
200 (6)	Wagner	1900	RP-2
200	G.E.	1800	Syn.
150	West.	257	Syn.
150	G.E.	400 (2200 V.)	KF

AC MOTORS — Cont.

150	G.E.	400	KF-TEFC
150	West.	600	Syn.
150	Cr. Wh.	900	
150 NEW	Reliance	1200	AA
150	G.E.	1200	2200
150	G.E.	1200	KT-583
150	Elec. Machy.	1800	Syn.
150	Reliance	1800	BB
150 (2)	G.E.	1775	KP
125	G.E.	164	Syn.
125	Cr. Wh.	720	
125	Wagner	1150	RP-2
125	West.	1800	CS-761C
100	Cr. Wh.	600	
100	G.E.	900	I-K
100	Wagner	860	RP-2
100 NEW	Reliance	1170	TEFC
100 NEW	Reliance	1170	BB
100	West.	1800	Syn.
100 NEW	Reliance	1760	TEFC
100	West.	1750	CS
100	G.E.	1750	K-504
100 NEW	Reliance	1765	BB
100	West.	1800	Syn.
75 NEW	Reliance	875	AA-5084
75	Elec. Machy.	900	Syn.
75	West.	1200	CS
75	G.E.	1150	KT-542
75	Wagner	1200	KP
75 NEW	Reliance	1150	AA-505
75 NEW	Reliance	1150	TEFC
75	West.	1750	CS-504
75 NEW	Reliance	1760	TEFC
75	Reliance	1750	AA-5058
75	Louis Allis	1800	Splash Proof
60	G.E.	865	KT-542
60 NEW	Reliance	1200	AA-5045V
60	Reliance	3600	TEFC
50	G.E.	720	KT-542
50	West.	900	CS
50 NEW	Reliance	1200	TEFC
50	G.E.	1200	KT-338
50 NEW	Reliance	1200	AA-445
50 NEW	Reliance	1800	TEFC
50 NEW	Reliance	1750	2200 V.

SLIP RING MOTORS
3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
400	West.	450	H.F.
200	Cr. Wh.	590	
200	West.	580	CW
150 (3)	West.	1150	CW-873C
150	Triumph	580	
75	Allis Chal.	695	
60	G.E.	570	MTC
60	Burke	1200	EM

CRANES

1 ton Euclid Overhead 29'6½" span. 8' lift. 220/440 V. 3 Ph. 60 Cy.
1 ton Euclid Overhead 29'10½" span. 8' lift. 220/440 V. 3 Ph. 60 Cy.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

TRADE WITH BAUER
BUY - SELL - TRADE
your
COMPRESSOR VACUUM PUMP STEAM BOOSTER
L.W.BAUER

BOILERS—TURBINES—ENGINES and AIR COMPRESSORS

Boilers 50-2000 HP; Turbo Gen. 100-6000 KW; St. Eng. Gen. 75-1000 HP. Write for our Free New List of High Grade Used Equipment.

BENJAMIN W. BISSELL, Reg. Engineer
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REFRIGERATION UNIT

275-ton Ingersoll-Rand barometric steam jet refrigeration unit, fully comp. with pumps, motors, and all access. equip. New 1943, used 2 yrs., condition like new. Detail specif. and price will be mailed on request.

PHILADELPHIA TRANSFORMER CO.
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BUSINESS PERSONNEL SELLING
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OPPORTUNITIES

May Be Sought From, or Offered To, the Readers of This Publication Through Its Classified Section
The Searchlight Section

DIESEL ENGINES

6—Cleveland Diesels, Model 1580-6, 330 B.H.P. at 270 RPM, 400 B.H.P. at 325 RPM, 4 cycle, solid injection, 6 cylinders. Complete accessories and auxiliary equipment. Excellent mechanical and operating condition.

PUMPS

3—Cameron #4RVL 20, 5" Centrifugal w/20 HP motor, 750 GPM 1113' TDH
2—Dayton Dowd CSLH, 2"x2½" Centrifugal, 100 GPM
2—Dean Hill, 6" ALC Centrifugal w/25 HP Motor, 1000 GPM 100' TDH
1—Dean Hill, SC 8" Centrifugal w/50 HP Motor, 2000 GPM 100' TDH
2—Goulds #1741, 2½x4" Pyramid w/2 HP Motor
1—GOULDS #3085, 5" Centrifugal w/20 HP Motor, 750 GPM 100' TDH
1—Goulds #3360, 6" Centrifugal 4 Stage w/350 HP Motor 1160 GPM 1260 TDH
1—National Transit, Model D w/3 HP Motor, 100 GPM at 420 RPM
4—Worthington, Type 2½ R2 Centrifugal 165 GPM
1—Worthington, Model 512, 5" Centrifugal w/25 HP Motor, 1000 GPM 100' TDH
(Used equipment—Excellent Condition)

PIONEER SUPPLY COMPANY
1550 So. 51st Ave., Cicero 50, Ill.
Townhall 3-0250

TURBINE-GENERATOR UNITS

Condensing—3 phase, 60 cycle

25,000 KVA-20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 215 P.S.I.G. 540-550° T.T. complete with direct connected shaft exciter, switchboard, a 30,000 square foot Westinghouse surface condenser and condensing accessories.

6250 KVA G.E., 5-stage, 2300/4160 volts, 200# P.S.I., 600° TT.

3750 KVA Westghse. 2300 volt, 200 PSI.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, 2-bearing generator **LESS TURBINE.**

2500 KVA Westghse. 2300 volt, 250 PSI.

1563 KVA Allis, 600 volts, 200 PSI.

1000 KVA G.E., 2300 volt, 250 PSI.

Non-condensing—3 phase, 60 cycle

1563 KVA G.E. 480 volt, 200-250 PSI, 15 to 20# ga. back.

940 KVA Allis 2300/480 volts, 125-150 PSI 12# back.

625 KVA G.E. 2300/480 volts, 125-150 PSI 20# back.

375 KVA Westghse-Moore 480 volts, 250 PSI 5-10# back.

125 KVA G.E., 2300 volts, 150-200 PSI.

125 KVA Westghse, 2400 volts, 150-250 PSI 10# back.

Direct Current

1000 KW G.E., 250 volt, 150 PSI, automatic extraction, condensing.

500 KW (2) Westghse. 3-wire, 250 volt, 285 PSI, condensing.

500 KW G.E., 250 volt, 200 P.S.I., 25# gauge back non-condensing.

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing.

100 KW (2) G.E., 125 volts, 200-275 PSI.

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (2) Elliott, 125 volt, 200-250 P.S.I. non-condensing, exciter sets.

UNAFLOW GENERATOR UNITS

3 Phase, 60 Cycle

625 KVA G.E. 240 volt generator connected 29" x 36" Skinner horizontal engine, 150 PSI complete.

500 KVA G.E. 240 volt generator connected Skinner Vertical engine 150-175 PSI complete.

375 KVA Westghse, 2400/480 volt generator connected Ames Vertical engine, 150 PSI.

175 KVA Westghse, 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E., 3-wire, 250 volts, 360 RPM generator connected Skinner vertical engine 150 PSI—5# back.

250 KW Crocker Wheeler 125 volt generator direct connected Ames Vertical non-condensing engine 150#.

20 KW Allis 125 volt generator connected Hill vertical Diesel engine.

UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Cherry 1-0210

STEAM POWER PLANT

5—714 HP Combustion Engineering WATER TUBE BOILERS, with Elesco Superheaters, Sturtevant High Pressure Economizers, Green Chain Grate Stokers, Hagan Combustion Controls, Copes Feed Water Regulators, Claraga Forced Draft Fans, Sturtevant Induced Draft Fans, Smoke Stacks. Good for 250# pressure by Hartford.

1—700 HP Stirling 4 drum Boiler with B&W Superheater, Green Chain Grate Stoker, Sturtevant Economizers, Sturtevant Induced Draft Fan, with Smoke Stack. Good for 250# pressure by Hartford.

2—8000 HP Webster Water Heaters.

1—MacLaslin Pivoted Bucket Conveyor System for handling coal and ashes. Approximately 300' long.

6—Steel Coal Bunkers, 80 tons each.

1—30" Wheeler Single Stage Circulating Pump, 30,000 GPM direct connected to 300 HP Allis-Chalmers Motor, 3/25/440, 360 RPM. (Has extra impeller for 15,000 GPM)

1—4"x6" Dayton-Dowd Centrifugal Pump direct connected to 125 HP General Electric-Curtis Steam Turbine.

1—100 KW General Electric 125 Volt DC Generator direct connected to a General Electric-Curtis Steam Turbine, 2-stage with reduction gear, Type SO, 3600 to 1200 RPM.

1—Type 1A-80 Wheeler Turbo Air Pump direct connected to 75 HP General Electric-Curtis 2-stage Steam Turbine, 1750 RPM.

1—6" Wheeler Centrifugal Condensate Pump direct connected to a 20 HP General Electric-Curtis 2-stage Steam Turbine, 1800 RPM.

1—Combination Circulating Pump and Condensate Pump driven by 190 HP General Electric single Stage Steam Turbine through a Westinghouse Reduction Gear, 3500 to 700 RPM.

1—2" 2-stage LeCourtney Centrifugal Pump, 200 GPM 650' Head at 3700 RPM direct connected to 53 HP Westinghouse Steam Turbine.

1—3000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 250 RPM, 600 Volts DC with 1—3150 KVA General Electric Transformer, 3 phase, 25 cycle, 6600/13200-445 Volts with starting panel and all instruments.

1—1000 KVA General Electric Synchronous Converter, Type HCC, 6 phase, 25 cycle, 750 RPM 600 Volts DC with 1—1050 KVA General Electric Transformer, 3 phase, 25 cycle, 13200/445 volts with starting panel and instruments.

1—500 KW Westinghouse Synchronous Converter, 6 phase, 60 cycle, 1200 RPM, 600 Volts DC with starting panel and instruments.

1—4000 KVA Westinghouse Transformer, 3 phase, 25 cycle, 13200/6600 volts.

7—700 KVA Westinghouse Transformers, single phase, 25 cycle, 7920/6600 volts to 13200 volts.

1—Kennecott Pressure Type Industrial Water Filter.

1—50-Ton Electric Traveling Crane—35'5½" Span.

Send for Complete Inventory

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2900 BRIGHTON BLVD.

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BARGAINS

1000 KW, 3 phase, 60 cycles, 480 volt General Electric Generator to a turbine designed for 200 lbs. pressure, 15 lbs. extraction, complete with condensor, pump and complete switchboard.

2—2000 amp., 3 pole, 15000 volt type FKR 255 B Gen. Elec. solenoid operated oil switches.

4—1600 amp., 3 pole, 15000 volt, type B 26 Westgh. solenoid operated switches.

We carry a large stock of all kinds of transformers, motors, etc. What have you for sale? What do you need?

KEYSTONE POWER PLANT EQUIPMENT CO.

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FOR SALE

MODERN 1000 KW Turbo-Generator

In Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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Engines and Generator Sets

1 to 2000 KW

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HEAVY DUTY DIESEL ENGINE

510 H.P. at 360 R.P.M., 5 cylinders, 4 cycle, 14½ x 18, vertical, type ZDSB. Non-reversing, with cold starting and mechanical injection. Engine is totally enclosed. Ideal for heavy duty pumping and dredge service.

The BOSTON METALS CO.

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CUrtis 5050

2500 H.P. 2300/3/60 SYNCHRONOUS MOTOR WITH CONTROL. Immediate delivery. Also several water-wheel electric complete plants—different sizes and heads.

SOUL CLINIC, INC., Calgary, Alberta, Canada

FOR SALE — EXCITER

1—Dual drive Exciter with 33 h.p. Westinghouse Steam Turbine and 30 h.p. Westinghouse motor driving 20 KW Westinghouse DC Generator including exciter panel and regulator.

Lignite Combustion Engineering Corp.

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Phone 407

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GUARANTEED GOOD BECAUSE REBUILT AND TESTED BY —HEMPHILL ELECTRICAL ENGINEERS—

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph.	Voltages
1	1500	Penna.	OISC	3	4150x2400
1	1500	GE	Pyranol	3	4150x2400
1	500	Kuhl.	OISC	1	4600x2300
2	400	Pitts.		1	2400/4800x240/480
1	333	GE	OISC	1	11200x220/440
3	333	West.	OISC	1	2300/575
1	200	GE	HT	3	2300x220
1	200	Pitts.	ODSC	1	4000x110/220
1	200	Mol.	C	1	2300x220/440
3	100	Wagner	HEB	1	240x120/120
1	100	Amer.		1	15000x2300
3	100	GE	Auto	1	4150Yx2400Y
9	50	GE	H	1	13750x125x216Y
1	50	Al. Ch.	ODSC	1	13530x120/240
2	50	Pitts.	Sub	1	13530x120/240
1	50	Amer.	OISC	1	6600/13200x220/440
1	50	Amer.	WF	1	240x240/30
1	50	GE	KS	1	2300x230
1	50	Amer.	AT	1	220/220/44
1	37½	GE	H	3	2200x110/220
1	37½	Amer.	RS	1	6900/13800x220/440
1	37½	Amer.	OISCID	1	6600/13200x220/440
2	37½	Amer.	AT	1	220x220/44

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	500	El. Mach.	720	TEFC	2200
1	150	GE	720	ATI	2300
1	150	GE	1800	TS	220
1	150	Whse.	900		220

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
7	1000	GE	514	600	2300/4150 3ph.
1	200	Whse.	900	250	220/440 3ph.
1	150	GE	120	125/250	2300 3ph.
1	150	Whse.	600	125	4150 3ph.
1	125	CW	1200	125	220/440 SC
1	100	GE	900	250	2300 3ph.
1	91	GE	1200	60	440 SC
1	94	GE	1200	60	4150 3ph.
1	30	GE	900	250	220 3ph.

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	1750	GE	4160	K	2600 Sq. Cg.
1	500	GE	440	TH	600
1	400	Whse.	150	CW	550
1	250	Whse.	600	CW	440
1	200	GE	1800	MT	2300
1	200	Whse.	600	CW	440
1	200	GE	600	MT	440

SLIP RING MOTORS—(Con't)

1	100	GE	600	IM	440
1	75	GE	1200	MT Vert	220
1	60	GE	1750	MT	220
1	60	GE	900	MT	440
1	50	GE	1730	MT	220
1	50	Whse.	900	CW	220
1	50	GE	1700	MT	220
1	50	GE	900	MT	220
1	40	G.E.	1200	MT	220

TURBO GENERATOR

250 KVA Elliott 208V 200# non-cond.

SPECIAL M.G., A.C. WELDER

1—176 KVA Whse., 220 V, 57 PF., 1200 RPM., 1 ph., with 75 HP Slip Ring, 440V, type CW, Exc. & Control

SPECIAL WELDING

1—150 KVA GE, type KWC, 1 ph., 550 V, sec. 12.22/6.05 V, Thryatron Spot and Seam, Control CR 7503

"FOR POWER"
J. L. HEMPHILL & CO.
1004 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-1777
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Member of the National Industrial Service Assn., Inc.

FOR SALE

1—Allis-Chalmers 500 KVA Transformer 60 cycle, 3 phase, 4000-460 volts non-burnable liquid filled.

ALSO

3—Westinghouse 200 KVA Transformers 60 cycle, single phase, 2400/4160Y and 240/480 volts, oil filled.

These transformers in good condition and available for immediate delivery.

AMERICAN HOIST & DERRICK COMPANY
W. R. Sprague — Purchasing Agent
63 South Robert Street
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COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

FOR IMMEDIATE DELIVERY

TURBO-GENERATORS—Condensing—500 to 20,000 KW; some extraction type, pressures 200 to 450#
TURBO-GENERATORS—Non-condensing—300 to 3000 KW. 150# to 450#, some extraction with high back pressure
STEAM GENERATORS—30000# to 100000# per hr. 150# to 450#
BOILERS—Water Tube, Stirling & Straight Tube types 200 to 450#
BOILERS—Fire Tube, 100 to 300 HP. 100 to 250#

TRANSFORMERS Quick Delivery, Various Sizes Rebuilt like NEW—Guaranteed. Motor-Generators, Rotaries, Frequency Changers, Large Motors & Diesel Generators.

Send us your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

SLIP RING MOTORS

220 or 440 volt, 60 cycle, 3 phase, slip ring Motors Rebuilt

H.P.	Make	Type	Speed	Description
400	G.E.	I-M	1200	S.B.
300	G.E.	I-M	1200	S.B.
200	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1200	S.B.
150	G.E.	I-M	1800	S.B.
100	G.E.	MT-300	1800	S.B.
100	G.E.	I-M	900	S.B.
100	G.E.	I-M	720	S.B.
75	G.E.	MT-343	1200	S.B.
75	G.E.	I-M	900	S.B.
75	West.	CW	720	S.B.
75	G.E.	I-M	720	S.B.
60	G.E.	MT-333	1800	S.B.
40	G.E.	I-M	1800	S.B.

BRAND NEW SQUIRREL CAGE MOTORS

Totally enclosed, fan cooled, explosion proof, open 220 or 440 Volt, 60 Cycle, 3 Phase

H.P.	Make	Type	Speed	Description
150	G.E.	K-6326	3600	TEFCBB
150	G.E.	K-6326	1800	TEFCBB
125	G.E.	K-6326	1200	TEFCBB
100	West.	CS-5075	1800	TEFCBB
100	West.	CS-504	1800	S. B. open
75	West.	CS-504	3600	TEFCBBXP
75	A.C.	ARZ	1800	TEFCBB used
75	West.	CS-504	1800	TEFCBBXP
75	West.	CS-445	1800	S. B. open

NEW SQUIRREL CAGE MOTORS

75	F.M.	QS-445	1800	B. B. open
75	West.	CS-505	1200	TEFCBBXP
60	West.	CS-5048	1800	TEFCBBXP
60	G.E.	K-5045	1800	TEFCBBXP
60	L.A.	QG-44	1800	B. B. open
60	F.M.	QS-444	1800	B. B. open
50	Master	FB-404	3600	TEFCBBXP
50	G.E.	K-445	1800	TEFCBB
50	G.E.	K-405	1800	S. B. drip
50	West.	CS-445	1200	S. B. open
50	G.E.	K-505	900	TEFCBBXP
40	A.C.	AR-444	3600	TEFCBBXP
40	G.E.	KF-3655	3600	B. B. Splash
40	West.	CS-405	1800	TEFCBB
40	L.A.	K-405	1800	TEFCBBXP
40	G.E.	404	1800	B. B. open

SQUIRREL CAGE MOTORS REBUILT

220 or 440 Volt, 60 Cycle, 3 Phase, Open

H.P.	Make	Type	Speed	Description
200	Wagner	RP-2-28	1800	S. B.
200	Wagner		1200	S. B.
200	G.E.	K-504	900	B. B. new
150	West.	CS	1800	S. B.
150	G.E.	I-K	1200	S. B.

REBUILT SQUIRREL CAGE MOTORS

H.P.	Make	Type	Speed	Description
150	G.E.	I-K	720	S. B.
100	West.	CS	1800	S. B.
100	G.E.	I-K	1800	S. B.
100	G.E.	I-K	1200	
100	G.E.	KT-347	1200	S. B.
100	West.	MS	1200	S. B.
100	West.	CS	900	S. B.
100	G.E.	I-K	720	S. B.
75	West.	CS	1800	S. B.
75	West.	CS	1200	S.B.
75	G.E.	I-K	900	
75	G.E.	KT-343	1200	S.B.
75	West.	CS-WL-607	1200	S. B. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-352	900	S. B.
75	G.E.	KT-346	720	S. B.
60	G.E.	KT-353	1800	S. B.
60	G.E.	I-K	1200	S. B.
60	West.	CS	1200	S. B.
60	G.E.	KT-346	900	S. B.
60	G.E.	I-K	900	S. B.
50	G.E.	I-K	1800	S. B.
50	Cr. Wh.	23R	1800	S. B.
50	G.E.	KT-327	1800	S. B.
50	G.E.	KT-336	1200	S. B.
50	West.	CS	1200	S. B.

We hav ein stock explosive proof motors 220/440/60/3 ranging in HP from ½ to 50 HP 900 to 1800 RPM.
We also carry in stock a large quantity of used electric motors from ¼ HP up to 500 HP., generators, transformers and control equipment. Upon receipt of your inquiries, we shall be glad to quote.

POWER EQUIPMENT COMPANY

8 CAIRN ST.—P. O. BOX 534—ROCHESTER 2, N. Y.—Telephone: Genesee 5629

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
500 (2)	2200	G.E.	900
500	2200	G.E.	450
450	440/220	Whse.	514
350	2200/440	G.E.	450
300	2200	G.E.	360
300	440	Whse.	2600
250	440/220	Whse.	600
250	2200/550	G.E.	450
250	550/440	G.E.	1200
250	440	G.E.	600
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1700
145	4000/2300	G.E.	1800
125	2200/440	G.E.	600
125	550/440	G.E.	1200
100	440/220	G.E.	600
100	440/220	G.E.	900

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	Kl. Mchy.	Sync.	600
240	2300/440	G.E.	ATI	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

PLATING UNIT

1—5,000 amp., 4/8 volt (or 2,500 amps., 8/12 volts) A.P. Munning, double commutater dir. conn. to 50 hp, G.E. sq. cage motor.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air
1—400 amp., 37000 v., G.E. Type FHKO-236 outdoor type, high interrupting capacity.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	440	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	2200	G.E.	KT	1200
300	2200	G.E.	FT	3600
250	440	G.E.	IK	720
250	2200	Al. Chal.	AB	1800
200	2200	G.E.	K	200
200	440	G.E.	IK	720
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1250
200	440/220	G.E.	KT	1800
150	440	Multi sp.	KT	1800/600
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
150	440/220	Howell	B. Brg.	1800
150	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150	440/220	G.E.	KTP	1200
150	440/220	G.E.	IK	514
150	2200/440	G.E.	KT	600
100	2200/440	G.E.	K	1200
75 (5)	550	G.E.	KP	1800

A. C. GENERATORS

1—329 kva, 600 rpm, 2300/410/220 V., G.E.
1—275 kva, 1200 rpm, 440 V., G.E.
1—250 kva, 720 rpm, 2300/410 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—187 kva, 1200 rpm, 440 V., Whse
1—150 kva, 900 rpm, 480/240 v., G.E.
1—100 kva, 720 rpm, 440 v., G.E.
3— 75 kva, 1800 rpm, 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	250 (2 new)	Cr. Wh.	CMC	1800
225	230	G.E.	CD	600
150	230 (2)	Whse.	8K	850
125	230	Whse.	8K	350/1050
100	230	Kl. Dyn.	30-3	475/1250
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	8K	850

MOTOR GENERATOR SETS

1—230 kw, 1200 rpm, 250 V., Whse., conn. to 375 HP, 1200 rpm, 2200 V., syn.
1—175 kw, 1200 rpm, 230 V., G.E., conn. to 250 kva, 1200 rpm, 2200/440 V., syn.
1—100 kw, 1200 rpm, 240/120 V., Al. Chal., conn. to 150 hp, 440 V., sq. cage.
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/400 v., syn. motor.
1—65 kw, 1200 rpm, 250 V., G.E., conn. to 100 hp, 1200 rpm, 440 V., synchronous.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage.

TRANSFORMERS 60 CY.

2—333 kva, G.E., 13,200—2300 V.
1—200 kva, Al. Chal. 4600/4160—240/120 V., 3 phase
3—250 kva, G.E., 2400-480 volts
3—250 kva, Whse., 11,000/22,000—2300 V.
3—200 kva, Whse., 2400—240/120 V.
1—150 kva, Whse., 8K, 13200-125/215 v., 3 ph.
3—150 kva, Al. Chal., 2400-240/120 V.
3—150 kva, Whse., 2400-240/480 V.
3—100 kva, Whse., 2400-240/480 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G.E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
6— 50 kva., G.E., 2400—120/240 V.
11—50 kva, Whse., 2300-110/220 V., dry

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HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

2—852 H.P. Springfield, Cross Drum Sectional Header Boilers, 225#, A.S.M.E.

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3—600 H.P. B.&W. Sect. Header Boiler, 200#.

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1—5000 KVA West. Cond. Extr. 60 cy. 480 V. 385-lb.
1—3750 KVA G.E. Cond. 60 cy. 2300 V. 185-lb.
1—2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb. BP
1—2500 KVA G.E. Cond. 60 cy. 600 V. 175-lb.
1—1875 KVA West. Cond. 60 cy. 2300 V. 170-lb.
1—1875 KVA G.E. Cond. 60 cy. 2300 V. 180-lb.
1—1563 KVA G.E. Extr. Cond. 60 cy. 2300 V. 200-lb.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 938 KVA G.E. Extr. Cond. 60 cy. 240 V. 200-lb.
1— 938 KVA West. Extr. Cond. 60 cy. 2300/4100 V. 200-lb.
1— 750 KVA G.E. Extr. Cond. 60 cy. 480 V. 200-lb.
1— 750 KVA G.E. Cond. 60 cy. 2300 V. 150-lb.
1— 625 KVA Worthington Non-C. 60 cy. 480 V. 125-lb. 10-lb. BP
1— 625 KVA West. Cond. 60 cy. 480 V. 150-lb.

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1— 600 HP Enterprise 440 V. 60 cy.
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1—250 KVA Ames Vertical Uniflow 480 V.
1—200 KVA Skinner Uniflow 230 V.
2—187 KVA Ames Vertical Uniflow 240/480 V.
1—156 KVA Ames Vertical Uniflow 240 V.

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QU.	KW	MFR.	VOLTS-DC	A.C.	RPM
1	2000	G.E.	600	4000	450
1	1500	G.E.	600	4150	600
2	1000	West.	660	4150	900
1	500	West.	125	2300	720
1	200	West.	275	2200	900
2	150	G.E.	250	2300	1200
1	150	West.	275	440	900
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS—60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
2	700	West.	2300	200
1	600	G.E.	440	1800
1	300	G.E.	2300	600
1	300	West.	2300	900
1	250	West.	440	600

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	3750	G.E.	25/60	300
1	3125	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300
1	1700	West.	60/24	720
1	625	A.C.	25/60	300

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1— 600 A. 73 KV G.E. FHKO-236-500
1— 400 A. 37 KV G.E. FHKO-136-250
1— 400 A. 37 KV G.E. FHKO-236-500
1— 600 A. 15 KV G.E. FHKO-138-750
2— 600 A. 15 KV G.E. FHKO-136-132B BS
1—1200 A. 15 KV G.E. FKO-138-340
1— 600 A. 15 KV G.E. FKO-139-350
2— 600 A. 15 KV G.E. FLO-15-250

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3—	75 KVA A.C.	66000/24000—7200/12470 Y
3—	200 KVA West.	45000—2400/7200
3—	150 KVA G.E.	44000—7200/12470 Y
3—	75 KVA West.	4600—7200/12470 Y
3—	8333 KVA West.	43800—13900
2—	900 KVA G.E.	36300—2300, 3 ph.
1—18750 KVA A.B.B.		34840—11000, 3 ph.
3—	150 KVA Wag.	33000—7200/12470 Y
3—	100 KVA A.C.	33000—7200/12470 Y
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3—	75 KVA Wag.	33000—7200/12470 Y
4—	450 KVA A.C.	25410/44000—13280/23000
3—	1250 KVA G.E.	23000—2300/4000
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3—	100 KVA G.E.	22000—7200/12470 Y
9—	50 KVA G.E.	22000—2300
6—	200 KVA G.E.	13200—2300
3—	200 KVA G.E.	13200—230/460
2—	200 KVA G.E.	11500—220/110
3—	200 KVA G.E.	11000—2300
3—	250 KVA Pitts.	7200—220/440
3—	200 KVA Wag.	7200/12470 Y—2400
3—	150 KVA Wag.	6900—2300
4—	100 KVA G.E.	6900/11900—2400
1—	37½ KVA G.E.	6900—230/460
3—	1500 KVA A.C.	2380/4000 Y—2300
3—	333 KVA G.E.	2300—230/460
1—	100 KVA G.E.	2300—575, 3 ph.
3—	100 KVA West.	2300—230/460
3—	75 KVA Mol.	2400—120/240
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3—	15 KVA Stand.	450/225—117 DRY TYPE

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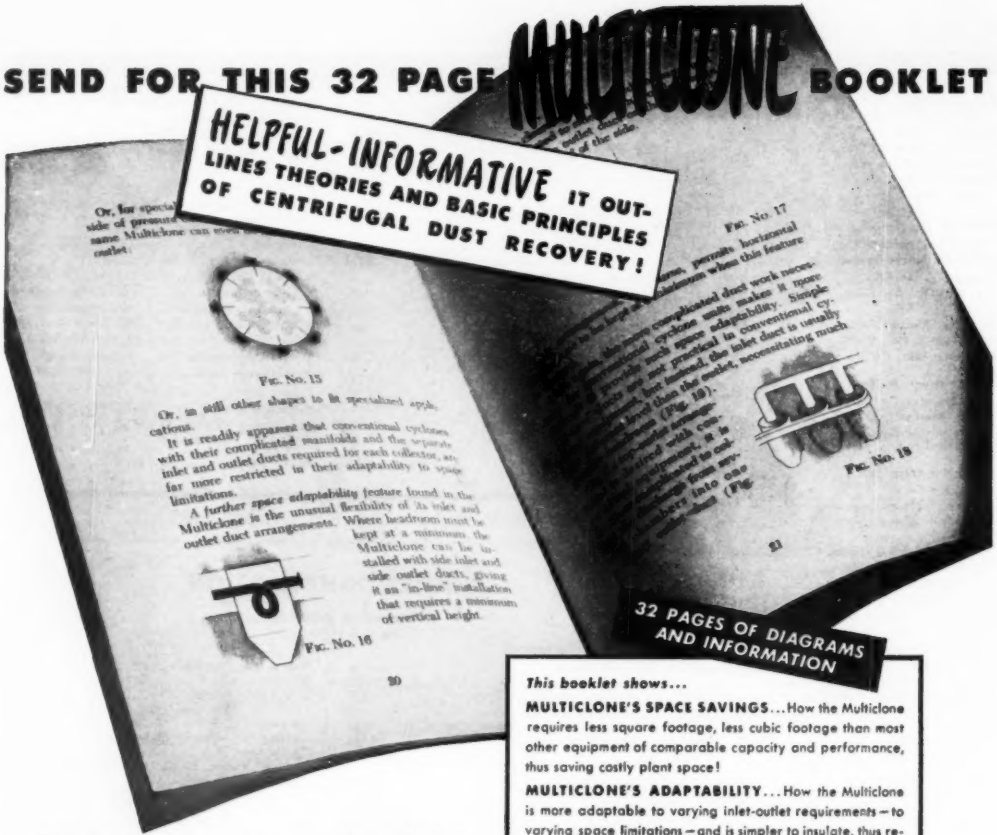
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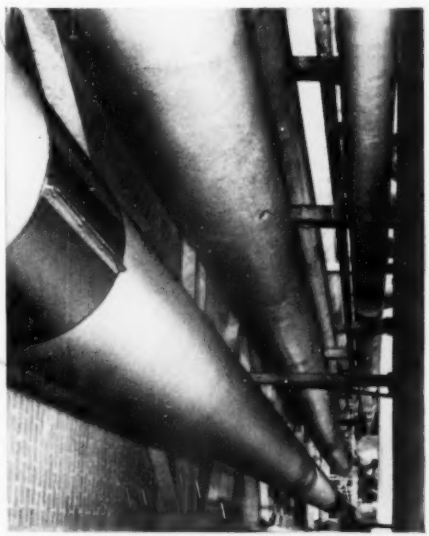

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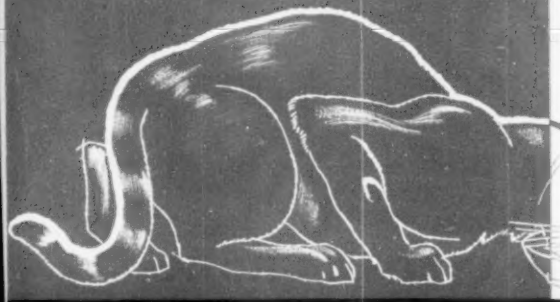

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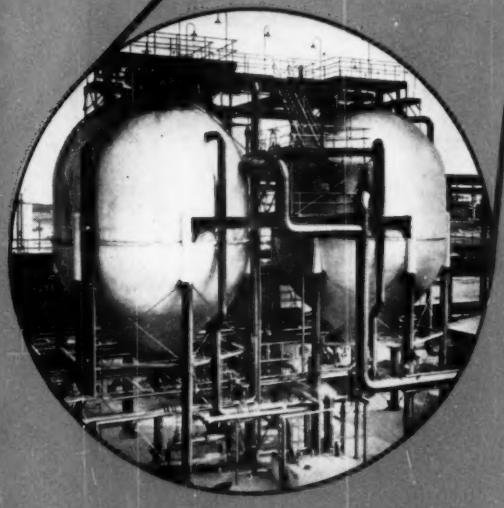

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